DISSERTATION ON

"COMPREHENSIVE MANAGEMENT OF DUODENAL INJURIES AND ITS OUTCOME"

Dissertation submitted to

THE TAMIL NADU Dr. M.G.R. MEDICAL UNIVERSITY

CHENNAI

with partial fulfillment of the regulations for the Award of the degree of

M.S. (General Surgery)

Branch – I

INSTITUTE OF GENERAL SURGERY,

MADRAS MEDICAL COLLEGE & RAJIV GANDHI GOVERNMENT GENERAL HOSPITAL,

CHENNAI.

May 2019

CERTIFICATE

This is to certify that, the dissertation entitled **"COMPREHENSIVE MANAGEMENT OF DUODENAL INJURIES AND ITS OUTCOME"**

Is the bonafide work done by **DR.N.MOHANASUNDARAM**, during his **M.S. (General Surgery)** course **2016-2019**, done under my supervision and is submitted with partial fulfilment of the requirement for the M.S.(BRANCH-I)- General Surgery of The TamilnaduDr.MGR Medical University, May 2019 examination.

Prof. M.ALLI M.S., D.G.O.,
Professor & Head of the Department,
Institute of General Surgery,
Madras Medical College,
Chennai – 03.

Prof. P.THANGAMANI, M.S.,FMAS., FAES.,
Professor ,
Institute of General Surgery,
Madras Medical College,
Chennai – 03.

DR. R. JAYANTHI M.D., FRCP,
THE DEAN,
Madras Medical College & Rajiv Gandhi
Government General Hospital,
Chennai-03.

DECLARATION

I, certainly declare that this dissertation titled **"COMPREHENSIVE MANAGEMENT OF DUODENAL INJURIES AND ITS OUTCOME"** represents a genuine work of mine. The contributions of any supervisors to the research are consistent with normal supervisory practice, and are acknowledged.

I also affirm that this bonafide work or part of this work was not submitted by me or any others for any award, degree or diploma to any other University board, either in India or abroad. This is submitted to The TamilNadu Dr. M.G.R Medical University, Chennai in partial fulfilment of the rules and regulations for the award of Master of Surgery Degree Branch I (General Surgery).

DATE:

PLACE: DR.N.MOHANASUNDARAM

(POST GRADUATE)

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"To acknowledge is to know gratitude".

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URKUND

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https://www.researchgate.net/publication/49793739_Management_of_duodenal_trauma
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7

CERTIFICATE II

This is to certify that this dissertation work titled "**COMPREHENSIVE MANAGEMENT OF DUODENAL INJURIES AND ITS OUTCOME** of the candidate **Dr. N. MOHANASUNDARAM** with registration Number **221611009** for the award of **M.S degree** in the BRANCH -1 of **General Surgery**. I personally verified the urkund.com website for the purpose of plagiarism Check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows 2 percentage of plagiarism in the dissertation.

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Telephone No.044 25305301
Fax: 011 25363970

CERTIFICATE OF APPROVAL

To

Dr.N.Mohanasundaram
I Year Post Graduate in M.S.General Surgery
Institute of General Surgery
Madras Medical College
Chennai 600 003

Dear Dr.N.Mohanasundaram,

The Institutional Ethics Committee has considered your request and approved your study titled **"COMPREHENSIVE MANAGEMENT OF DUODENAL INJURIES & ITS OUTCOME" - NO.18062017**

The following members of Ethics Committee were present in the meeting hold on **06.06.2017** conducted at Madras Medical College, Chennai 3

1. Prof.Dr.C.Rajendran, MD.,	:Chairperson
2. Prof.R.Narayana Babu,MD.,DCH., MMC,Ch-3	: Deputy Chairperson
3. Prof.Sudha Seshayyan,MD., Vice Principal,MMC,Ch-3	: Member Secretary
4. Prof.N.Gopalakrishnan,MD,Director,Inst.of Nephrology,MMC,Ch	: Member
5.Prof.A.Pandiya Raj,Director, Inst. of Gen.Surgery,MMC	: Member
6.Prof.Rema Chandramohan,Prof.of Paediatrics,ICH,Chennai	: Member
7.Prof. Susila, Director, Inst. of Pharmacology,MMC,Ch-3	: Member
8.Prof.K.Ramadevi,MD., Director, Inst. of Bio-Chemistry,MMC,Ch-3	: Member
9.Thiru S.Govindasamy, BA.,BL,High Court,Chennai	: Lawyer
10.Tmt.Arnold Saulina, MA.,MSW.,	:Social Scientist
11.Tmt.J.Rajalakshmi, JAO,MMC, Ch-3	: Lay Person

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary - Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

INTRODUCTION

INTRODUCTION:

Duodenal trauma is uncommon but nowadays it is seen more and more frequently due to the increased automobile accidents and violent events. The management of duodenal trauma can be complicated, especiallymassive injury to the pancreatic-duodenal-biliary complex occurs simultaneously. Even if the patients receive surgeries on time, multiple postoperative complications and high mortality are common.

The duodenum and pancreas can be injured simultaneously; isolated injuries are rare. Coexisting injuries are common (50-98%), with an average of 3 to 4 for each patient. [3-6]

Due to its complicated anatomy, the diagnosis of duodenal trauma is difficult. The diagnostic accuracy is low and the rate of missed diagnosis is high. After duodenal trauma is confirmed, a surgery should be carried out as soon as possible. The mortality for duodenal injuries ranges from 6% to 29% & 30% of the injuries are directly related to fatal outcome. The variability in morbidity & mortality is caused by several factors: the presence of coexisting injuries, the mechanism of injury, the time of diagnosis, the presence or absence of major ductal injury, and duodenal perforation, which are considered to be predictors of outcome. [7]

The probability of complications after duodenal trauma ranges between 30% and 60% and in many cases is the result of missed findings or diagnostic delays or both. Delayed diagnosis and therapeutic interventions often result in a difficult clinical course with a dubious outcome.

Coexisting injuries and fatal hemorrhage are responsible for early deaths, while infections and multi organ failure cause most late ones. Common complications of duodenal & pancreatic injuries include pancreatitis, pseudocysts, fistulas, intraabdominal abscesses, pneumonia, and anastomotic breakdown, and these are related to the development of MODS & Septicemia. [8-10]

About 37% of late deaths are primarily attributable to the injury itself and usually occurs within 1-3 weeks of the injury or later. The time between the injury, diagnosis and definitive treatment is an important factor in the development of complications and their resulting mortality. When a definitive diagnosis is delayed more than 24 hours, up to 40% of patients are at risk of death, as oppose to 11% of those patients operated on within 24 hours. [11-13]

And the surgery isdone according to the location of trauma and the affected adjacent organs.

AIMS AND OBJECTIVES

- To analyse and compare the management of Duodenal injuries
- To asses the role of early diagnosis and varied management
- To assess the severity of injuries and complications with varied management

REVIEW OF LITERATURE

HISTORICAL PERSPECTIVE

Since the dawn of health care, the management of the injured patient has been a major priority for the practising surgeon. The American College of Surgeons 1913, formed Committee on Trauma COT 1949 & it developed the National Trauma Data Bank NTBD – which is the largest database of trauma patients in existence, currently including more than 6 million patients from 758 trauma centres. The American Association for the Surgery of Trauma AAST originated in 1938 is the oldest & largest of all trauma professional organisations.

The Abdomen is a commonly injured body region & frequently requires the care of a surgeon for definitive management. By 2012 NTBD, 14.8% of all patients who sustained abdominal injuries, with penetrating mechanisms being proportionately greater than blunt (23.8% vs 12.1%). The vital nature of the organs contained within the abdomen makes evaluation and management a priority. The predominant sources of morbidity & mortality are bleeding & visceral perforation with associated sepsis. In the setting of blunt trauma, solid organs often sustain contusion or laceration, causing bleeding that may require surgical management. Furthermore, blunt forces can be a cause of injury to hollow viscera due to rapid compression of a segment of intestine containing fluid & air. Penetrating mechanisms directly lacerate solid & hollow viscera, resulting in bleeding & intra-abdominal contamination that often require surgical repair.

The immediate management of abdominal injuries includes the initiation of resuscitation & rapid assessment for sources of bleeding. Patients in shock require the administration of crystalloid solutions & blood products to support cardiovascular function as bleeding is controlled. Furthermore, a rapid survey for bleeding including assessment of abdomen is completed to prompt transfer to the operating room when needed. Retained foreign bodies traversing the abdominal wall should be maintained throughout the initial evaluation and protected from excessive movement. These should then be removed only after defining a definitive plan, which almost always includes abdominal operations to manage associated injuries.

Small intestine is one of the most frequently injured organs after penetrating abdominal trauma. Series have reported the incidence to be as high as 60% in patients with penetrating abdominal trauma, although recent data from the NTDB demonstrated significantly lower presence of small intestinal injury (12.9%) [1]. Mortality rate range from 15 to 20%, with most caused by associated vascular injuries [2]. Penetrating injuries can range from tiny perforations to large destructive injuries that devitalize circumferential segments of small bowel. Blunt injuries of small bowel are less common, present in 1.7% of all blunt abdominal injuries in the NTBD, although these injuries are associated with a significant mortality rate of 14%. At the tissue level, injury can be secondary to crushing, rupture, and shearing mechanisms. Direct tissue injury can occur when the small bowel is crushed between the steering wheel or seat belt and a rigid structure, such as the vertebral column.

Small bowel rupture occurs when the intraluminal pressure rapidly increases, causing a blow-out along the antimesenteric border. Deceleration mechanisms can result in a shearing of the serosa or muscularis throughout a segment of small bowel. Finally, injuries to the small bowel mesentery can result in devascularisation and subsequent intestinal necrosis without direct tissue injury.

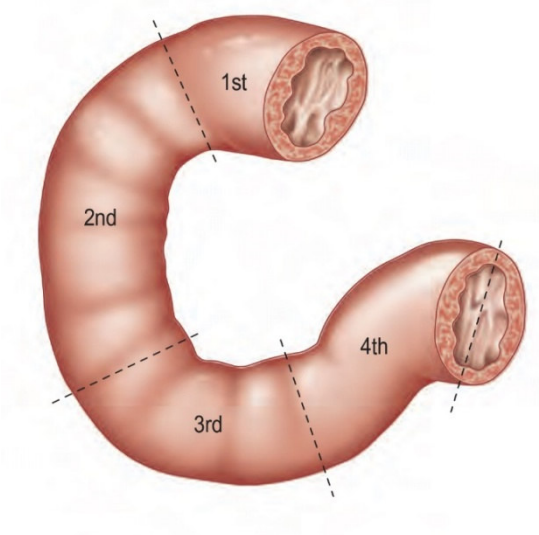
In the setting of penetrating mechanisms, small bowel injuries are often identified at the time of abdominal exploration. Patients may have peritonitis on examination at the time of presentation, or their abdominal examination findings may worsen in the hours after presentation. As with other hollow abdominal viscera, the evaluation can be challenging and is similar to the evaluation of the stomach and duodenum. Abdominal CT imaging has significant limitations, and a high index of suspicion must exist to avoid a missing injury.

The repair of the small bowel injuries depends on the amount of intestinal wall destruction in relation to the overall luminal circumference. Injuries to the intestinal serosa can be reinforced with interrupted nonabsorbable suture, which imbricates the injury. Small perforations can be repaired primarily with one or two layers after debridement of devitalized tissue. Care must be taken to avoid overly compromising the size of the intestinal lumen. In the setting of multiple perforations, primary repair still be safely performed as long as the injuries are not so close to result in narrowing

of the bowel lumen when closed. Despite this, many surgeons chose to perform a resection with anastomosis when multiple perforations are present within a segment of bowel. When injuries involve more than 50% of the intestinal wall circumference, bowel resection with anastomosis should be performed. There has been no difference in the leak rates demonstrated between stapled and hand-sewn anastomosis following resection. Selection of the anastomosis technique should be based on the surgeon and the amount of experience with the chosen technique. Hand-sewn anastomoses are frequently constructed in two layers, but single layer techniques are equally efficacious. Damage control for small bowel injuries includes rapid closure of perforations to control contamination with resection when large injuries are present. Patients in shock may benefit from resection without immediate anastomosis because of higher risk of anastomotic dehiscence and the need for an abbreviated operation. The abdomen is temporarily closed, and the patient is resuscitated to correct physiological derangements. After resuscitation, intestinal continuity can be re-established on re-surgery.

ANATOMY

The adult duodenum is approximately 25cm long and is the shortest, widest and most predictably placed part of the small intestine. The proximal 2.5cm is intraperitoneal and the remainder is retroperitoneal. The duodenum forms an elongated "C" that lies between the level of first and third lumbar vertebrae in the supine position. The lower 'limb' of the C extends further to the left of the midline than the upper 'limb'. The head and uncinate process of the pancreas lie within the concavity of the duodenum, which is 'draped' over the prominence formed by the lumbar spine; the duodenum therefore curves in an anteroposterior direction as well as forming a 'C'. [21] The duodenum lies entirely above the level of umbilicus. It is described as having four parts.



FIRST/ SUPERIOR PART:

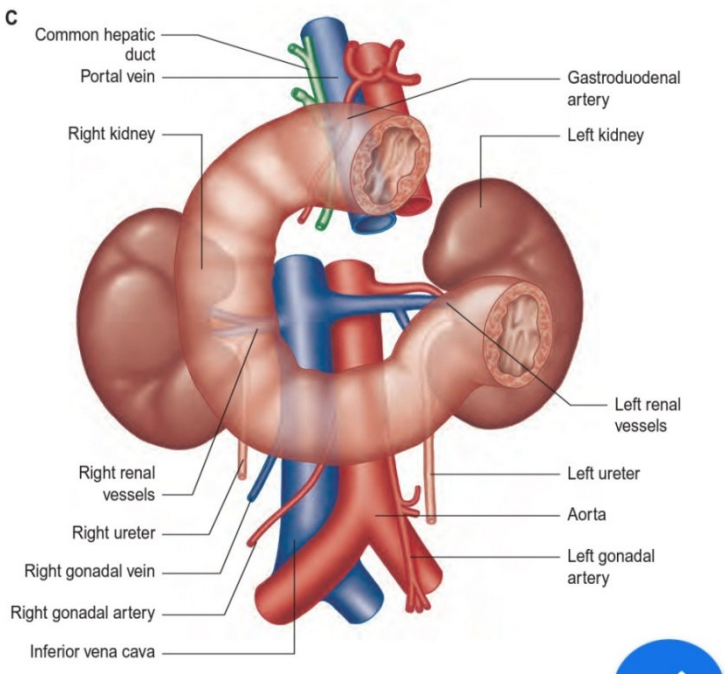
- Most mobile part, 5cm long.
- Starts at the duodenal end of pylorus and ends at the superior duodenal flexure.

- Proximal 2.5 cm is intraperitoneal & distal 2.5cm is covered by peritoneum on its anterior & superior surfaces and forms the inferior boundary of the epiploic foramen.
- It is frequently called as 'Duodenal cap'.
- On contrast studies, it shows a few longitudinal folds continuous with pylorus and has a triangular appearance; on plain radiographs as, isolated triangular gas shadow to the right of L1 or L2.
- It passes superiorly, posteriorly and laterally for 5cm before curving sharply inferiorly at superior duodenal flexure to become more retroperitoneal.
- The section below duodenal cap lies posterior and inferior to quadrate lobe of liver.
- It lies anterior to gastroduodenal artery, common bile duct and portal vein, anterosuperior to head and neck of pancreas.
- The junction of 1st and 2nd part of duodenum lies posterior to the neck of the gallbladder.

SECOND/ DESCENDING PART:

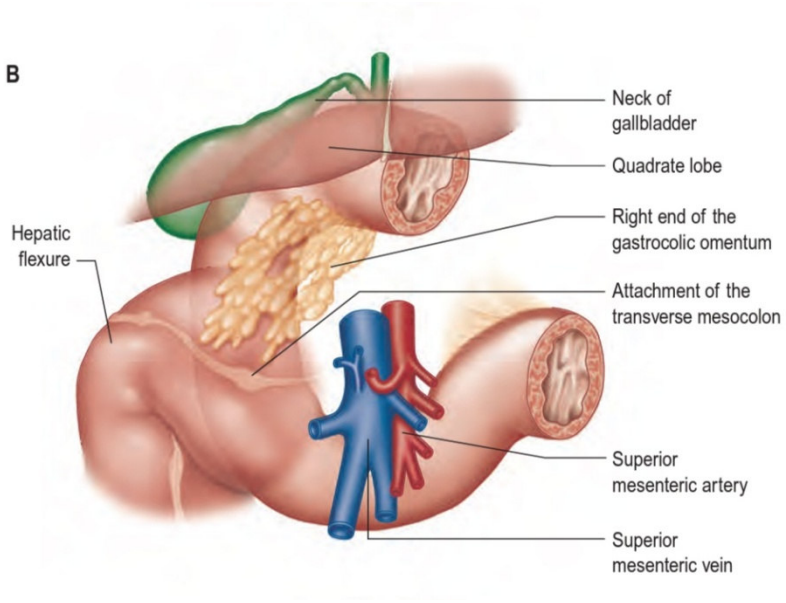
- 8cm long, starts at superior duodenal flexure and runs inferiorly in a gentle curve, convex to the right side of vertebral column and extending to the lower border of L3, then sharply medially at the inferior duodenal flexure.

- It lies posterior to gall bladder and right lobe of liver, and is crossed anteriorly by the transverse colon.
- This part of duodenum is at risk of injury during the surgical mobilization of the ascending colon and hepatic flexure.
- It lies anterior to the hilum of the right kidney, the right renal vessels, the lateral edge of the inferior venacava and the right psoas major.
- The head of the pancreas and the common bile duct are medial and hepatic flexure is above and lateral.
- Part of the pancreatic head is sometimes embedded in the medial duodenal wall, and the pancreatic 'rests' in the duodenal wall may produce small filling defects on contrast radiology.
- The common hepatopancreatic ampulla of Vater opens on the summit of the major duodenal papilla, a mucosal elevation situated on the posteromedial wall of the second part, 8-10 cm distal to the pylorus.
- A second, accessory pancreatic duct is sometimes present and opens about 2cm proximal to the major papilla on a minor duodenal papilla.



THIRD/ HORIZONTAL PART:

- 10cm long, starting at the inferior duodenal flexure, runs from the right side of the lower border of the L3 vertebra, and passes to the left and slightly superiorly, anterior to the inferior venacava and abdominal aorta, becoming continuous with the ascending fourth part.
- It lies posterior to the transverse mesocolon, and is crossed anteriorly by the origin of the small bowel mesentery and superior mesenteric vessels.
- It lies anterior to the right ureter, right psoas major, right gonadal vessels, inferior venacava and abdominal aorta (at the origin of the inferior mesenteric artery), and inferior to the head of the pancreas.
- Anteroinferiorly, loops of jejunum lie in the right and left infracolic compartments.
- The mid portion lies in the angle between the SMA anteriorly and the abdominal aorta posteriorly.



FOURTH/ ASCENDING PART:

- 2.5cm long, starts just to the left of aorta, runs superiorly and laterally to the level of the upper border of the L2 vertebra, then turns sharply anteroinferiorly at the duodenojejunal flexure to become continuous with the jejunum.
- The inferior mesenteric vein lies either posterior to the duodenojejunal flexure or at its lateral margin beneath a peritoneal fold.
- Posteriorly: the aorta, left sympathetic trunk, left psoas major, left renal and left gonadal vessels are found. Posterolaterally: the left kidney and left ureter. Anteriorly: the transverse colon and mesocolon, stomach more anteriorly. Superiorly: the inferior border of the body of the pancreas.
- At its left lateral limit, the duodenojejunal flexure is suspended from the retroperitoneum by a double fold of peritoneum called the suspensory ligament of duodenum of Treitz.

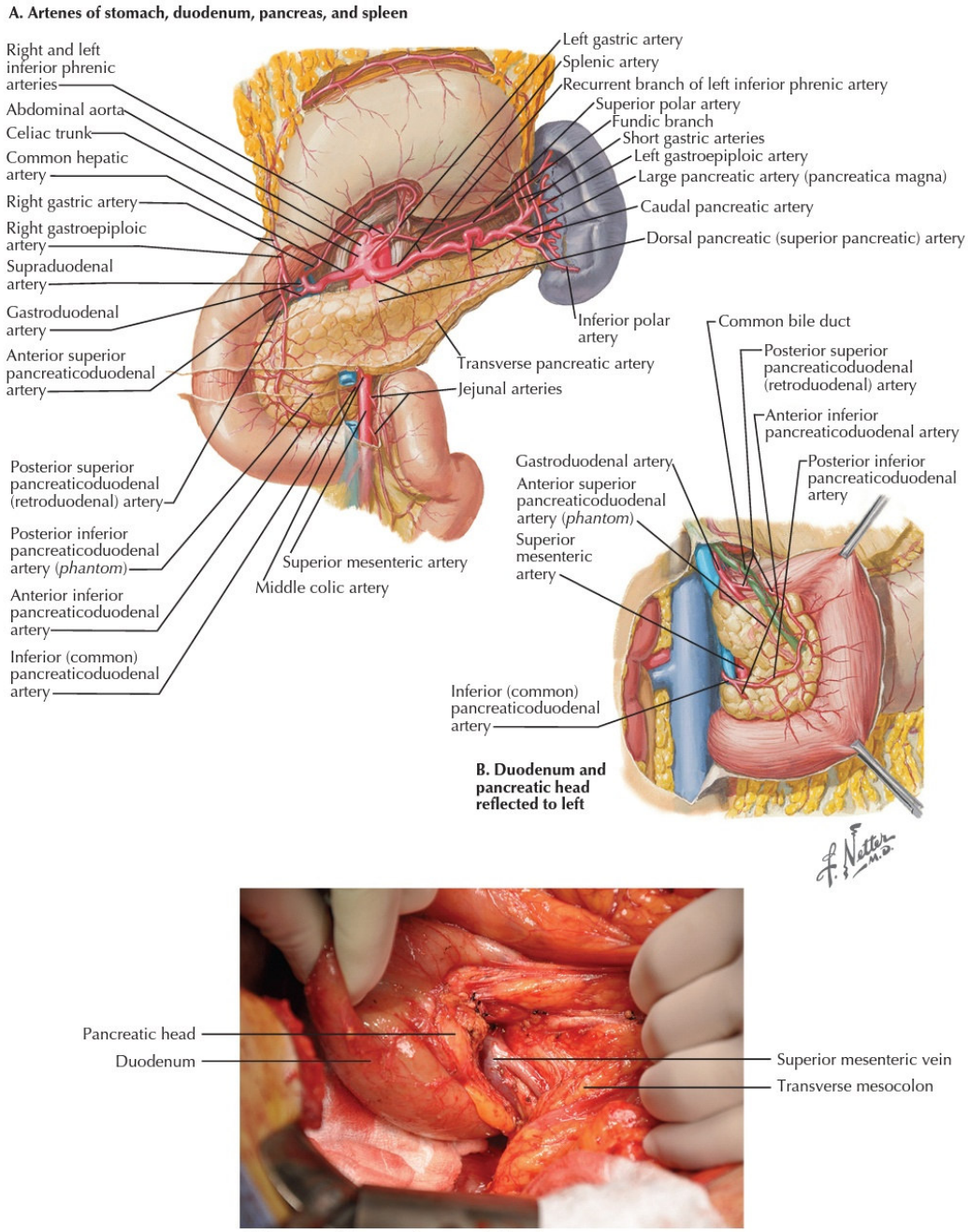
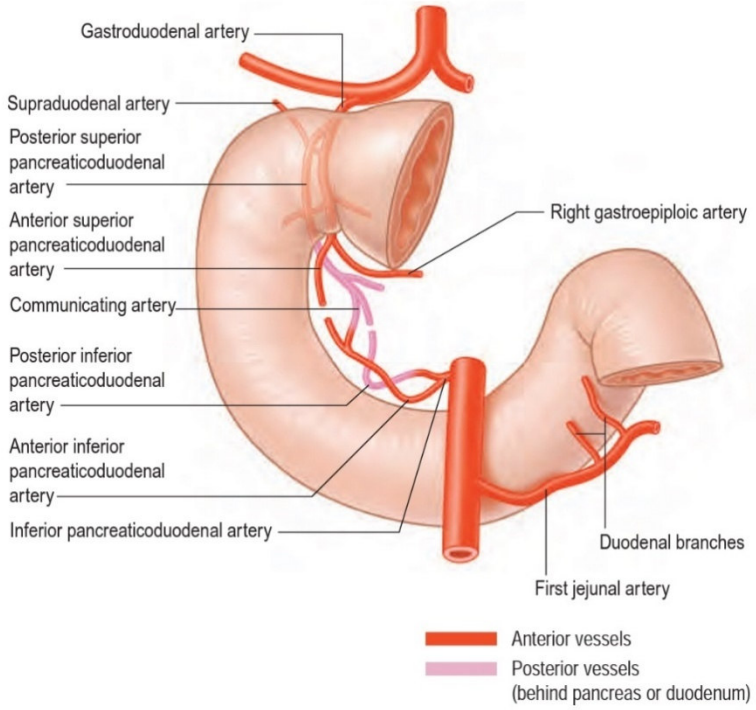


FIGURE 16–2 Arterial supply of stomach and duodenum.

VASCULAR SUPPLY:

The main vessels supplying the duodenum are the superior and inferior pancreaticoduodenal arteries. [22-27] The first and second parts also receive contributions from other sources, including the right gastric, supraduodenal,

right gastroepiploic, hepatic and gastroduodenal arteries. Branch of superior pancreaticoduodenal artery may contribute to the supply of the pyloric canal, anastomosing to a minor extent with gastric arteries within the muscular layer of the pyloroduodenal junction.



GASTRODUODENAL ARTERY:

Arises from common hepatic artery behind or above the first part of duodenum, descends retroperitoneally& it gives off the posterior superior pancreaticoduodenal artery, several retroduodenal branches, supraduodenal artery. As it emerges below the lower border of 1st part of duodenum it gives off right gastroepiploic artery and several pyloric branches. It descends below the anterior surface of pancreas dividing into anterior superior pancreaticoduodenal artery and pancreatic branches. They supply the 1st& 2nd part of duodenum and the head of pancreas.

INFERIOR PANCREATICODUODENAL ARTERY:

Arises from the Superior mesenteric artery or its first jejunal branch, near the superior border of the third part of the duodenum. It crosses behind the superior mesenteric vein and passes behind the uncinate process of the pancreas, where it divides into anterior and posterior branches. They supply the pancreatic head, uncinate process, D3 & D4. They finally get anastomosed with superior pancreaticoduodenal arteries.

JEJUNAL ARTERY BRANCHES:

Branches from the first jejunal branch of SMA supply the 4^{th} part of duodenum.

VEINS:

Submucosal and intramural veins give rise to small veins that accompany corresponding named arteries. The superior pancreaticoduodenal vein drains into portal vein. The inferior pancreaticoduodenal vein drains into superior mesenteric vein. Small veins from 1^{st}& 2^{nd} parts of duodenum drains directly into portal vein. Small veins from 3^{rd}& 4^{th} part of duodenum drains directly into Superior mesenteric vein. Numerous small anastomosis are present between veins of the 2^{nd}& 3^{rd} parts of duodenum and retroperitoneal veins.

LYMPHATIC DRAINAGE:

Superior & inferior pancreaticoduodenal, supra & infra pyloric, hepatoduodenal, common hepatic, celiac, superior mesenteric nodes and para-aortic nodes.

INNERVATION:

Sympathetic: T5 to T12, Greater & Lesser splanchnic nerves, celiac plexus, synapse in the celiac & superior mesenteric ganglia.

Parasympathetic: Vagal nerve.

TRAUMA EVALUATION

The initial resuscitation, diagnostic evaluation, and management of the patient with blunt or penetrating injury is based on protocols from the Advanced Trauma Life Support (ATLS) program, established by American college of Surgeons on Trauma.

INCIDENCE:

Due to the increased incidence of traffic accidents and unpredicted injuries, duodenal injuries are seen more and more frequently. [14] According to the best estimates, duodenal injuries occur in 4.7% of all patients with abdominal injuries. The reported incidence of duodenal injury ranges from 3.7% to 5% in the literature and it is often accompanied by other abdominal injuries because of the close anatomic relationship to liver, gallbladder, pancreas, etc. [15] The majority of duodenal injuries are caused by penetrating trauma. Blunt injury is infrequent but difficult to diagnose because of its vague clinical symptoms and signs. It is reported that the second portion of duodenum is injured most commonly, approximately in one third of the cases reported. [16] Injury to these retroperitoneal structures may be suspected based upon the injury mechanism and identification of injury to organs in close proximity to duodenum or pancreas. [17]

INJURY MECHANISM:

Approximately 75 to 85% of blunt injuries to the duodenum and pancreas are caused by motor vehicle collisions. [17,18] The mechanism is typically due to crushing of these fixed peritoneal organs between the L1 & L2 and steering wheel or seat belt. The remainder of blunt duodenal and pancreatic injuries results from falls & assaults. [17,19,20] Blunt duodenal and pancreatic injury can also be due to bicycle accidents in which duodenum and pancreas are crushed between vertebra and bicycle (or motorcycle) handlebar.

They also occur when acceleration and deceleration forces act on the mobile and non-mobile portions of the duodenum, such as during a fall from height. [35-40]

Any implement or missile that enters the abdomen can injure the duodenum or pancreas. Gunshot or shotgun wounds are more likely to result in injury compared with stab wounds because of their high energy. However, depending upon the girth of the victim and force applied, even a short implement that penetrates the upper abdomen can cause duodenal or pancreatic injury.

ASSOCIATED INJURIES:

The liver is the most commonly injured organ, accounting for 17% of associated injuries. Other organs injured included the pancreas 12%, small bowel 12%, colon 12%, stomach 9% and vascular injuries 15%.

Because of the proximity of the major vascular structures including the aorta, venacava and portal vein, injury to the duodenum and pancreas can be associated with exsanguinating hemorrhage. Major abdominal veins are injured in 10% of patients, mostly involving the inferior venacava, and major arteries were injured in 7% of patients.

<table>
<tr><th colspan="3">Mechanism of injury with possible variations in the type of force exerted on the upper abdomen and the associated affected anatomic structures [32-34]</th></tr>
<tr><td>Mechanism of injury</td><td>Location of force exerted</td><td>Anatomic structures affected</td></tr>
<tr><td rowspan="3">Seat belt injury
Deceleration trauma
Handlebar compression
Sports injury
Falls
Blows to upper abdomen
Child abuse (infants)</td><td>Midline</td><td>1. Pancreatic neck
2. Duodenum
3.Left Hepatic lobe</td></tr>
<tr><td>Right Upper Quadrant</td><td>1. Pancreatic head or uncinate process
2. Descending and Transverse Duodenum</td></tr>
<tr><td>Left Upper Quadrant</td><td>1. Pancreatic body or tail
2. Transverse and Ascending Duodenum</td></tr>
</table>

ANATOMIC LOCATION OF INJURY:

The most common duodenal injury sites were the second portion (36%), the third portion (18%) and the fourth portion (15%). The least common duodenal injury site was the first portion (13%) and the injuries in the multiple portions were found in 18%.

CLINICAL EVALUATION

History and physical examination are nonspecific and are not reliable for detecting duodenal injury. A history of any blunt injury mechanism causing a blow or crushing injury to the midabdomen raises the suspicion for duodenal injury.

Abdominal tenderness and peritoneal signs on initial evaluation may indicate the presence of intraabdominal injury but are not specific for duodenal injury. A physical examination finding of abdominal wall ecchymosis may be a sign that a crush injury has occurred. In blunt abdominal injuries due to motor vehicle accident, significantly more patients who presented with abdominal wall ecchymosis or the seat belt sign had an intestinal injury (21% vs 2%) or intraabdominal injuries requiring surgery (36% vs 4%) compared with those who did not have ecchymosis. [28]

Grey Turner's and Cullen sign may be present in patients with pancreatic trauma.

The thoracic and lumbar spine should be carefully palpated for spinal tenderness which may indicate the presence of a spinal fracture. Approximately one third of the patients with transverse vertebral body fractures (chance fractures) of the lower thoracic or lumbar spine have intraabdominal injuries [29].

When patients are being observed following trauma, the following clinical symptoms and signs may suggest an undiagnosed duodenal injury [30,31]

- Increasing abdominal pain
- Increasing abdominal tenderness
- Persistent vomiting or inability to take oral diet
- Unexplained hypotension
- Increasing leucocytosis
- Increasing amylase
- Proximal small bowel/ gastric outlet obstruction
- Abdominal sepsis.

LABORATORY FINDINGS

The most common test is the analysis of serum amylase activity in patients with associated pancreatic injury. However due to its low sensitivity and specificity, it is not used for emergency cases to decide on laparotomy. In cases managed conservatively it can be of some use regarding the progression of the disease. It is determined at 6^{th} hourly intervals. A persistent elevated injury may rise a suspicion of duodenal injury. Leucocytosis will be there in patients presenting late.

DIAGNOSIS

The diagnosis of duodenal injuries requires a high level of suspicion. Delayed diagnosis and management of these injuries results in increased morbidity and mortality. After a blunt trauma, the chances of duodenal injury is diagnosed only with suspicion. Information should include the haemodynamic condition of the patient, the condition in which the vehicle was found, condition of the steering wheel, the direction of force of impact and path to remove the victim from the vehicle. [53]

In secondary examination, the retroperitoneal location of the duodenum usually precludes early detection of injury by physical examination with minimal findings. Signs of defence, abdominal rigidity and absence of bowel sounds indicate intraabdominal injury. Severe testicular pain and priapism have also been reported in cases of duodenal injury due to pain transmission through the sympathetic fibres running along the gonadal vessels. [54]

IMAGING

Because of the retroperitoneal location of the pancreas, the initial physical examination, Diagnostic Peritoneal Lavage (DPL) and Ultrasonography are insensitive in detecting duodenal injury.

ABDOMINAL X-RAY:

Abdominal X-ray is useful only if it is positive, the presence of gas surrounding the right kidney being one of its characteristic signs. With "coil spring sign", found in the gastrointestinal barium X-ray, which could be diagnostic of intramural haematoma in the Duodenum. [55] The presence of intraperitoneal free air is also observed in some patients, more in penetrating trauma than in the patients with blunt trauma. [56]

COMPUTED TOMOGRAPHY:

The best method to visualise the retroperitoneal organs is a COMPUTED TOMOGRAPHY scan with intravenous and oral contrast. Despite the fact that the use of CT scans is limited to the stable patients with normal kidney function, it is capable of showing retroperitoneal ruptures of the duodenum, apart from the other retroperitoneal organs, detecting injuries of the hollow viscera and quantifying free blood.

MULTIDETECTOR CT PROTOCOLS:

It enables high resolution scans. The detector collimation of primary axial images is 0.6 – 2.5mm and pitch is 1.0 – 1.8, depending on the available scanner technology. In the standard CT, the axial images are cut between 2.4 to 5.0 mm thickness. The thinnest possible slice thickness should be used for creation of multiplanar reformatted and maximum intensity projection images. The sagittal and coronal images are used routinely at 1.8 – 2.5 mm thickness. The curved planes along the pancreatic or retroperitoneal axes are to clarify findings.

The absence of pancreatic parenchymal phase (35-40 second delay) in whole body CT is an obvious limitation of standard portal venous emergency abdominal CT. Combined scans with a whole-body protocol & CT angiography technique are used in most of the patients with multiple trauma. Pancreatic parenchymal phase in follow-up CT can be beneficial, because this scanning phase allows the highest contrast of the pancreatic parenchyma, duodenum and retroperitoneal structures. [59-63]

A volume of 100-150ml (2ml/kg) of contrast medium (iodine, 300-370mg/ml) is injected at 3-6 ml/sec with a delay of 60-70seconds in the portal venous phase. Arterial scans (25-30second) delay in a whole-body CT protocol or a dedicated pancreatic CT protocol (35-40 second) delay. [64,65]

Delayed scanning is performed 2-3 minutes lately. It is helpful in the suspected case of abdominal (pancreatic) haemorrhage.

The use of oral contrast is controversial, optionally given in one or two doses of 400-600ml. The standard CT technique includes the use of positive contrast media, if possible. If isolated injury of the duodenum is suspected, dedicated technique can be applied, by using large quantities of sodium bicarbonate or butylscopolamine as negative oral contrast to distend duodenal wall.

Imaging techniques: With the availability of 64 slice and higher CT scanners, the entire scan can be acquired in the arterial phase. This facilitates optimal detection of vascular injury [80]. The portal venous phase CT was the most accurate scan in detecting pancreatic duct injuries [81]. Thin sections are routinely acquired for better visualisation of the main pancreatic duct, which normally measures 3mm to 4mm [80]. 3D post processing techniques, such as curved planar reformats, appear to improve detection and characterization of pancreatic lacerations [82]. However, further investigation is needed to confirm the utility of these techniques in trauma setting.

The injured duodenum & pancreas may appear normal on CT images, particularly in the first 12 hours after trauma [83,84]. Sensitivity of the CT may improve with time after injury, as tissue damage from activated pancreatic secretions and peripancreatic inflammation evolves over time. Therefore, a repeat CT in 24-48 hours may be warranted for patients with persistent symptoms [85]. The mechanism of injury and recognising the subtle signs on CT are crucial to early and accurate diagnosis of the duodenal and pancreatic trauma.

Abdominal CT findings in Duodenal injuries:

- Duodenal wall thickening >4mm,
- Peri-duodenal fluid,
- Fluid in the right anterior pararenal space,

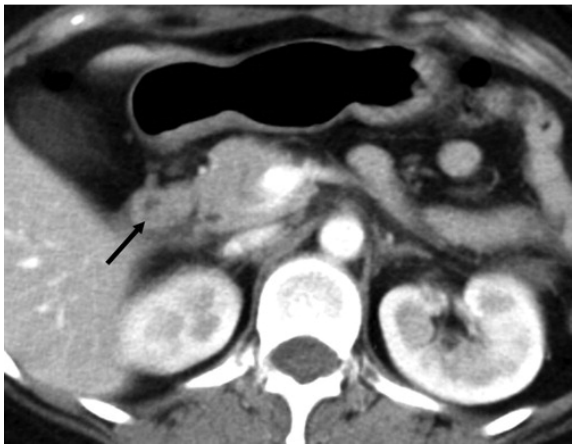
- Diminished enhancement of the injured duodenal wall segment,
- The sentinel clot sign- highly attenuating heterogenous fluid (clot) accumulation near the site of injury, [57]
- Findings of intraluminal or extraluminal air. [58]
- Retroperitoneal collection of contrast medium,
- Lack of continuity in duodenal wall,
- Stranding of retroperitoneal fatty tissue,
- Pancreatic transection.

PITFALLS:

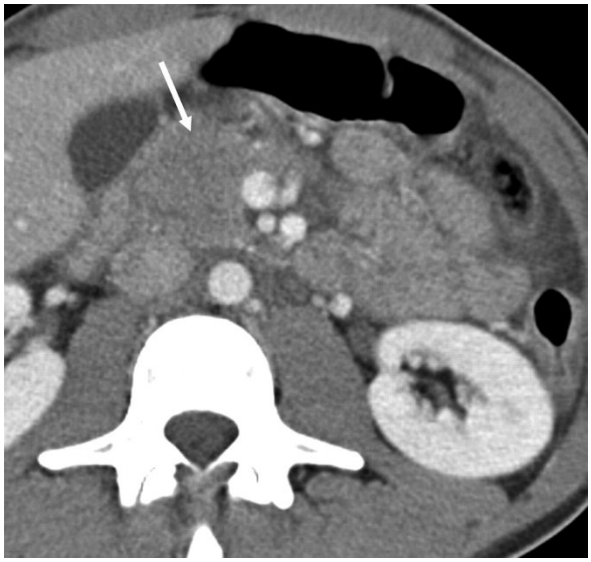
- Duodenal diverticulum simulating retroperitoneal air,
- Retroperitoneal hematoma from a non-duodenal source, and
- Unopacified bowel loops adjacent to the duodenum which may obscure subtle findings.

Retroperitoneal perforation of the duodenum can be visualised in the CT scan as the leakage of intestinal contents into lesser sac. These perforations are typically contained and located in this cavity, but occasionally may be in communication with the peritoneal cavity through the foramen of Winslow and produce pneumoperitoneum. Gastrograffin can be used as oral contrast to reveal the perforation site. The contrast medium should be administered slowly through a nasogastric tube so that the duodenal bulb is filled properly, and its distal end should be preferably be in the gastric fundus.

Right decubitus position is the ideal position. If no leakage is observed, the patient should be placed in the supine position and X rays repeated, including stomach and duodenum. The test is completed by placing the patient in the left lateral position, which allows better visualisation of the antrum and duodenum. The best method to visualize the retroperitoneal organs is CECT Abdomen & Pelvis with oral & IV contrast. [66]

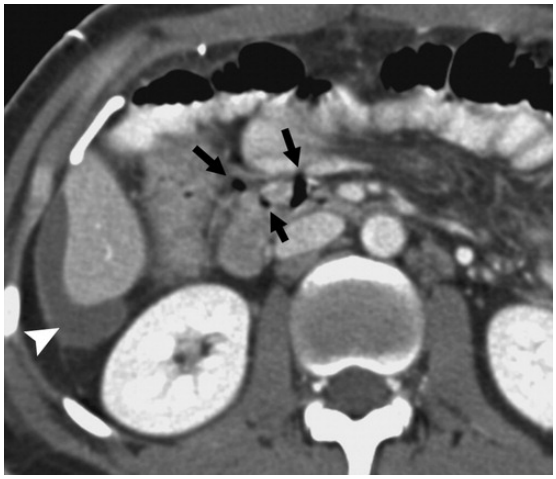


Grade I Duodenal injury: Axial CT image shows thickening of the duodenal wall in the descending part without evidence of free air. There is stranding of the peripancreatic fat.

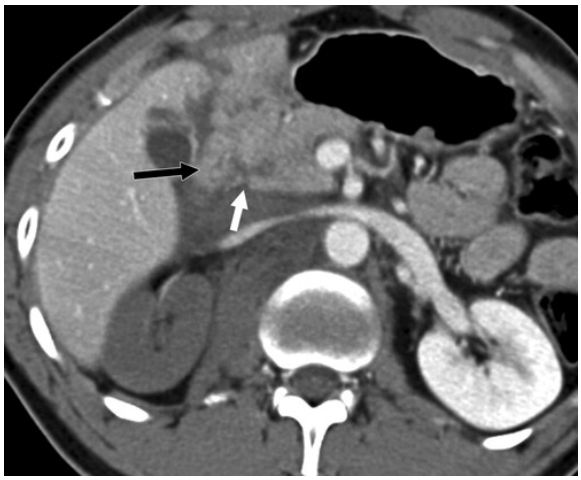


Grade I Duodenal injury: axial CT image shows an enlarged pancreatic head with mild edema

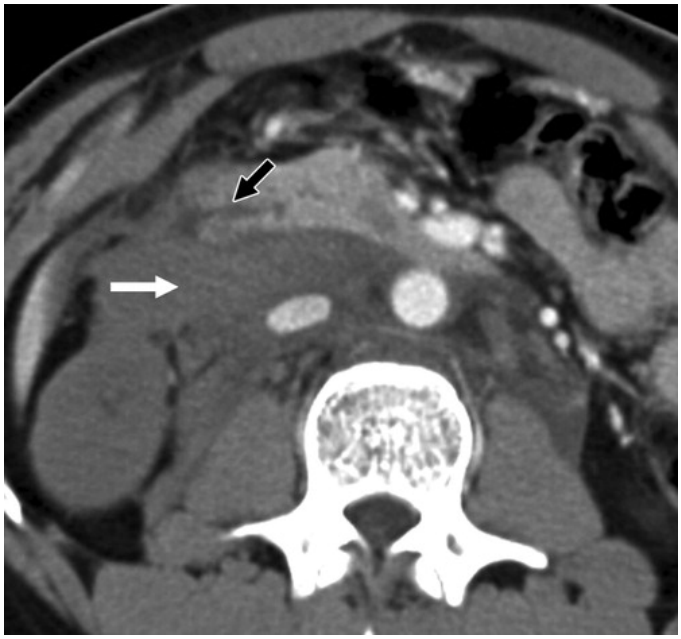
Grade II Duodenal injury: CT image obtained at a lower level shows thickening of the duodenal wall in the descending part. Adjacent to the duodenum is a small collection of extraluminal air, which indicates a small grade II laceration of the wall.



Grade II Duodenal injury: Axial CT image shows a grade II injury of the horizontal part of the duodenum with small collections of extraluminal air. A subscapular hematoma is present at the lower pole of the right liver lobe.



Grade III Duodenal injury: Axial CT image showing thickening of the duodenal wall in the 2nd part. At the transition zone to the horizontal part, there is disruption of the wall. There is also a retroperitoneal haematoma and hypoperfusion of the right kidney due to right renal artery occlusion.



Grade III injury: CT image obtained at lower level shows the disruption with large surrounding extraluminal hematoma.

The sensitivities of 16 channel & 64 channel multidetector abdominal CT were 54% and 52.4%, respectively, with specificities of 94.8% and 90.3% respectively.

In a study [67] which included 30 patients with duodenal blunt trauma, 18 underwent CT scanning as a method for diagnosing duodenal injury, and in most cases (15 patients), it was performed within the first 4hours after hospital admission. The presence of intraperitoneal free fluid was the common finding, 11 cases being reported (73%), followed by detection of duodenal haematoma in 6 (40%) and pneumoperitoneum in 5 (33%). Moreover, in 4 patients (27%) with complete duodenal rupture, the CT scan was interpreted as normal. The

“pathognomonic sign” of duodenal trauma, such as the presence of retroperitoneal air and contrast extravasation, only occur in a minority of cases.

Another study[68] has described 2 patients with duodenal perforation secondary to blunt abdominal trauma. The CT scan showed thickening of the duodenal wall, interruption of the contrast medium flow and presence of extraluminal gas and fluid as consistent findings of duodenal injury.

The integrity of the pancreatic duct is established with Cholangiopancreatography only.

ENDOSCOPIC RETROGRADE CHOLANGIOPANCREATOGRAPHY:

The most accurate imaging technique to detect and localize pancreatic ductal injury. [69]

In patients with traumatic injuries, ERCP is indicated for haemodynamically stable patients with computed tomography of the abdomen being inconclusive for the suspected pancreatic ductal injury, or suspected during a period of observation or postoperatively.

Some ductal injuries of the pancreas identified by ERCP may be conducive to management with percutaneous or endoscopic techniques (e.g. biliary stent, pancreatic stent).

MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY:

It may demonstrate the associated pancreatic parenchymal abnormalities not visualised on ERCP [70-72]. It also demonstrates parenchymal and peripancreatic abnormalities, along with pancreatic laceration, haematoma, contusion, and peripancreatic fluid [77-79]. MRCP in combination with the intravenous administration of secretin, has been successfully employed to improve the characterisation of pancreatic ductal anatomy, ductal disruptions and ongoing leakage [73,74]. An MRCP facilitated secretin test can be performed with a dynamic, breath hold, 2-dimensional single shot RARE heavily T2-weighted sequence, along the coronal plane. No post processing required. Secretin is given as a synthetic agent intravenously, improves visualisation of the pancreatic duct by increasing the calibre of the duct almost immediately and peaking between 2 and 5 minutes [75,76].

Advantage of MRCP is that it is non-invasive.

Disadvantages of MRCP for the diagnosis include

- It is more specific for pancreatic injury than duodenal injuries,
- Is time consuming,
- Monitoring the injured patient while the test is being performed can be difficult,
- There is no opportunity for treatment and is not widely available.

MANAGEMENT

INJURY GRADING:

The most widely used injury classification system is from the American Association for the Surgery of Trauma and Organ Injury Scale Committee (AAST-OIS) [88]. Although injury management does not correlate exactly with grade, injury scales provide a practical means by which to communicate the severity of the injury. The severity of the injury is estimated based upon findings of computed tomography or during exploratory laparotomy.

GRADE	INJURY	DESCRIPTION
I	Haematoma	Involves only one duodenal portion.
	Laceration	Partial laceration, without perforation.
II	Haematoma	Involves more than one duodenal portion
	Laceration	Less than 50% disruption of the circumference.
III	Laceration	50% - 75% disruption of D2 circumference.
		50% - 100% disruption of D1, D3 & D4 circumference.
IV	Laceration	More than 75% disruption of D2 circumference.
		Involves the ampulla or the distal portion of the common bile duct
V	Laceration	Massive disruption of the duodenopancreatic system
	Vascular	Duodenal devascularization.
Advance one grade for multiple injuries in the same organ.		

NONOPERATIVE/CONSERVATIVE MANAGEMENT:

Nonoperative management of duodenal injuries is safe for patients with blunt Grade I or Grade II injuries (Haematoma). Nonoperative management has not been reported for penetrating injuries. Patients found to have ductal injury using CT OR ERCP/MRCP are not candidates for nonoperative management.

Conservative management consists of gastrointestinal decompression and nutritional support, as indicated. For the patients with the symptoms of proximal bowel obstruction due to duodenal hematoma, a nasogastric tube is placed for decompression and parenteral nutrition via central line is initiated. After 5 to 7 days, imaging should be repeated to evaluate the grade and patency of the duodenum. If there are any features of obstruction even after 10 to 14 days, exploratory laparotomy is indicated. If there is no obstruction then oral diet can be started [91].

Intramural Duodenal Haematoma is caused by a blunt abdominal trauma and may occur in any part of the duodenum. It is associated with coagulation disorders, anticoagulant therapy and alcoholism. They are due to the vascular rupture inside the duodenal wall. Most of them are subserosal. They are treated conservatively with nasogastric tube and parenteral nutrition. Wait for 2-4 weeks for resolving, if not surgery is indicated.

NUTRITION:

Early enteral nutrition is preferred over intravenous TPN for most injured patients. However, placing and maintaining enteral access in patients with blunt duodenal injury who are conservatively managed can be challenging. Post pyloric placement of a nasoenteric feeding tube may not be possible and surgical feeding jejunostomy may be necessary [92-98].

Feeding jejunostomy should be placed for most of the patients during the repair of the duodenal injuries prior to abdominal closure [96]. There are insufficient data to recommend routine jejunostomy in all cases of operative duodenal or pancreatic injury given that about 4% of trauma patients will end up in complications related to surgical jejunostomy (e.g., soft tissue infection, leak, enteric fistula, bowel obstruction) [99,100]

In patients with higher grade like Grade III & IV, the benefits of early enteral access and nutrition via FJ is more beneficial than its complications, thus, prior to the abdominal closure decompressing gastrostomy, retrograde jejunostomy for duodenal decompression, and antegrade tube jejunostomy for enteral feeding is known as Triple tube/ostomy.

SURGICAL MANAGEMENT:

The immediate control of bleeding from the major vessels or from the solid organs like spleen, liver or kidney is the first and gold standard manoeuvre in abdominal trauma surgery, followed by local trauma repair. Thorough laparotomy should be done to visualize most of the organs. In cases

of duodenal injuries, the entire duodenum, including its four portions, must be carefully explored. There is suspicion of the presence of duodenal injury if there is bile in the duodenal wall, duodenal subcutaneous emphysema, free biliary fluid, the retroperitoneal haematoma around the duodenum or a perirenal haematoma. The duodenum is visualised by Kocher manoeuvre, Cattel and Braasch manoeuvre, or both. These enable visualisation of the anterior and posterior walls of all the four parts of the duodenum.

Evaluation of the duodenum is mandatory for injured patients who undergo exploratory laparotomy for other injuries. Following control of abdominal haemorrhage or gastrointestinal contamination, the visible areas of the retroperitoneum should be inspected for bile staining, entrapped air bubbles, and peri-duodenal & peripancreatic haematomas.

- First a Kocher manoeuvre is done by dissecting the lateral peritoneal attachment of the duodenum to expose the D1, D2and D3, along with head and neck of pancreas.
- Gastrocolic ligament is divided to allow entry into the lesser sac and inspectionof the posterior aspect of the first portion of the duodenum, the medial aspect of the D2 and anterior aspect of the pancreas.
- Divide the retroperitoneum inferior to the pancreas to inspect the posterior pancreas after mobilising and lifting the inferior edge of the pancreas,
- D3 is exposed with the right medial visceral rotation,
- Mobilize the ligament of Treitz to expose the D4 and pancreas.

The duodenum should be examined thoroughly to evaluate for a full thickness injury. During exploratory laparotomy when there is haematoma in the duodenum, it should be left intact since it can be managed conservatively. By an attempt to evacuate this haematoma, the partial thickness injury may turn into full thickness injury. Perihematomal drain should be placed post procedure and if there is any expanding haematoma or blood loss, it should be then addressed. [91]

Most duodenal perforations are seen upon inspection. Subtle full thickness injuries can be identified by instilling Methylene Blue through the nasogastric tube and looking for the subserosal staining of the dye. Full thickness injury in the region of ampulla, bile ducts, and pancreatic ducts is seen using the MRCP/ERCP. [101]

The trauma surgeon must be able to handle different surgical procedures based on the complexity of the injuries. Adjacent manoeuvres to protect the duodenal closures like Tube Duodenostomy should be used.Tube Duodenostomy is divided into three types

1. Primary: when the tube is inserted in an orifice different from the wound,
2. Antegrade: where the duodenum is decompressed by passing a tube through the pylorus towards the duodenum and
3. Retrograde: where the tube is passed through the jejunostomy site.

SURGICAL TECHNIQUES AND PROCEDURES TO REPAIR DUODENAL AND DUODENOPANCREATIC INJURIES:

- Duodenorraphywith external drainage/ Drain tube
- Duodenorraphy with duodenostomy tube
    - Primary through the duodenum
    - Anterograde through the pylorus,
    - Retrograde through the jejunum.
- Triple ostomy technique (Gastrostomy, Duodenostomy and Jejunostomy)
- Jejunal serosal patch
- Jejunal mucosal patch
- Vascular pedicles from
    - Ileum
    - Jejunum
    - Stomach (Gastric island)
- Duodenal resection
    - Duodenal duodenostomy
    - Duodenal jejunostomy
- Duodenal diverticulization:

    Antrectomy and Gastrojejunostomy, Truncal Vagotomy, wound excision and Duodenorraphy, Duodenostomy, Kehr's tube and Feeding Jejunostomy.
- Pyloric Exclusion:

    Temporary pyloric closure and transit reconstruction by Gastrojejunostomy.

- With suture (absorbable and nonabsorbable)
- With mechanical suture

- Duodenal Pancreatectomy or Whipples procedure.

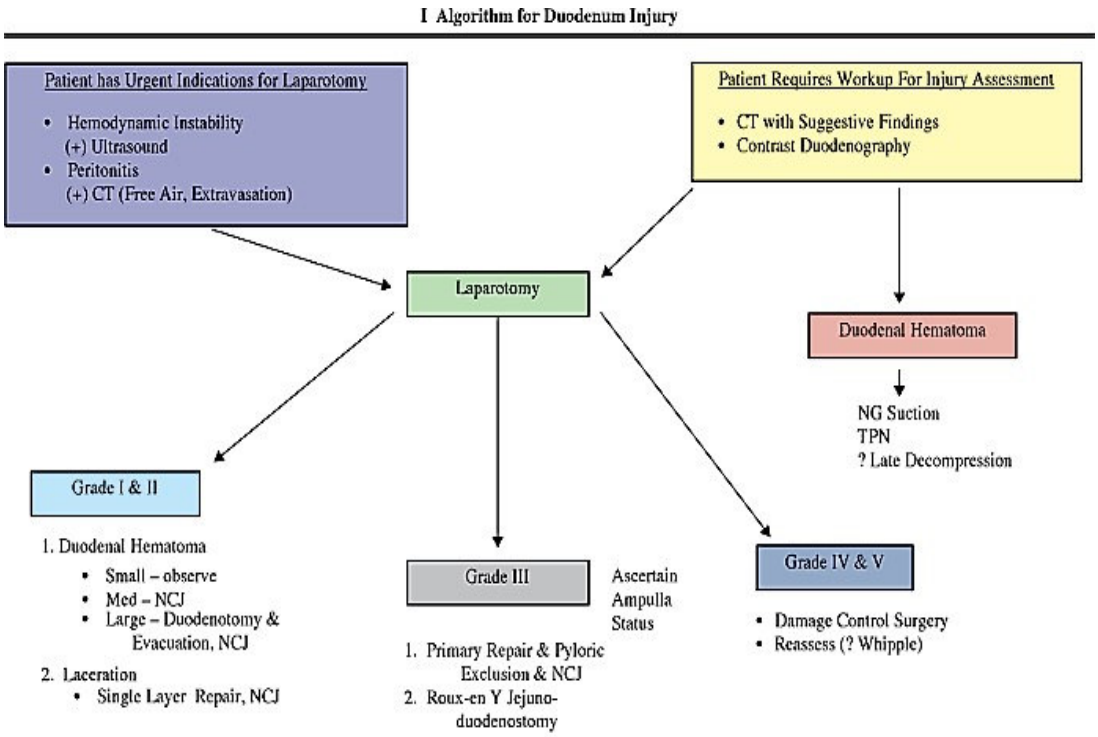
Damage control:

Damage control surgery involves immediate control of bleeding sites (including the associated injuries) and gastrointestinal contamination with delayed management of injuries that are immediately life threatening including duodenal and pancreatic injuries. Intraperitoneal packing and temporary abdominal closure with replacement of blood are followed by fluid resuscitation, patient warming and correction of coagulation deficits in the ISCU. [109]

In Duodenal injures, it involves rapid closure of the injured segment or resection of a full thickness injury without establishing a definitive procedure for continuity and doing Ostomies. [110] For the suspected pancreatic injuries, wide drainage is used. In case of distal pancreatic injury, distal pancreatectomy with or without splenectomy is done as needed.

Bleeding from the pancreas can be usually controlled by packing, however, high grade injuries to the head of pancreas, involving duodenum may need urgent resection. To resect the proximal duodenum and the pancreas, the pylorus, pancreatic neck, and proximal jejunum are stapled across and transected, the common bile duct is ligated and the biliary tract is drained by

tube cholecystectomy [111].Closed suction drains are placed to control duodenal and the pancreatic secretions. Following resuscitation and stabilization, definitive procedures like Whipples can be performed.



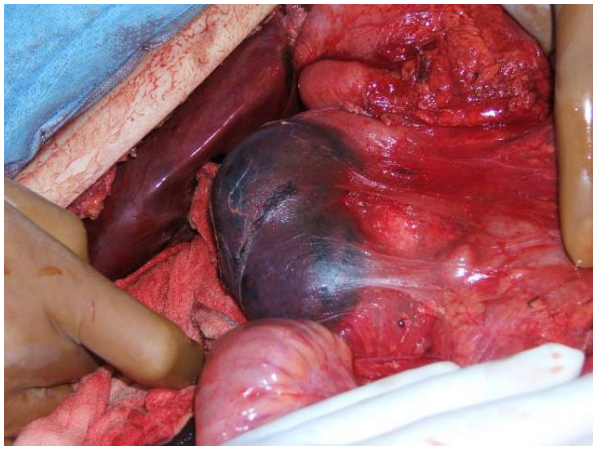
Definitive procedures:

- **Low grade:**
  - Partial thickness injuries like Grade I is repaired by doing Lembert Seromuscular simple suture with nonabsorbable suture.
  - Full thickness duodenal lacerations like in Grade II are debrided and primary repair is attempted with Tension free closure in 2 layers. Longitudinal injuries are closed transversely to minimize the chances of potential luminal narrowing.

- If the injury is too extensive for the primary repair like >3cms after debridement, the injured segment should be resected and duodenal ends should be brought together with end to end Duodenoduodenostomy. [112]
- Injuries to the 2nd part of the duodenum may not be amenable to this approach if there is associated pancreas, bile duct or pancreatic duct injuries.

➢ **Intermediate grade:**

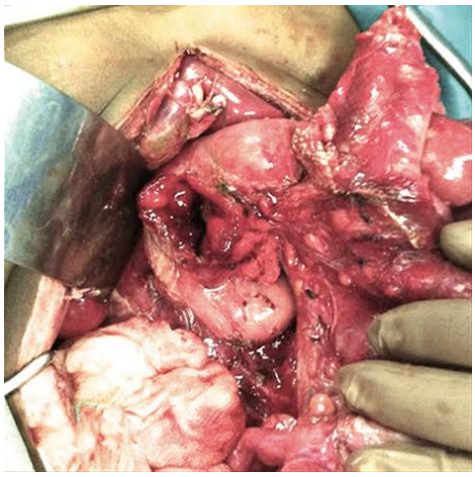
- Grade III injuries are also treated with debridement and primary closure or resection with primary anastomosis.

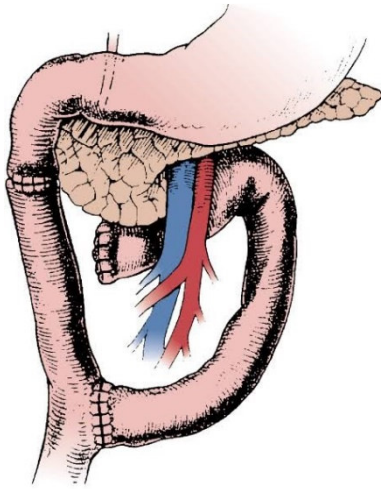


➢ **High grade:**

- Injuries involving the ampulla as Grade IV & V, increase the complexity of the procedure to be done. For limited injuries to the ampulla, management options include stenting or sphincteroplasty [113].
- Avulsion o the ampulla of Vater can occur and is successfully managed by doing Choledochojejunostomy. [114,115]

- Extensive periampullary injuries, such as intraduodenal bile duct injury, intrapancreatic bile duct injury or Grade V injury often require staging Pancreaticoduodenectomy. [116]





Isolated duodenal haematomas are managed conservatively except in patients with acute abdomen, sepsis, or uncontrolled bleeding. [119,120]

In 1979 Stone and Fabian [102] introduced the use of the duodenostomy tube as “Triple Ostomy”. They included 237 patients and only 1 case of Duodenal fistula was registered vs 8 patients with duodenal fistula in patients without Tube Duodenostomy.Another study showed that between external and tube decompression 9 fistulas vs 5 fistulas respectively.

Since 1960s, the use of mucosal or serosal patches appeared as a tool within the range of surgical options in the cases of duodenal trauma, that models have shown that the apposition of serous membrane of mobilised jejunal loop to seal full thickness, non reconstructible duodenal injuries induced mucus coat in 6 to 8 weeks. [103-105]

In 1970s, advances in the techniques, which used, pedunculated jejunal mucosal flaps anastomosed to the defect with double-layer technique and a pedunculated Gastric island from the greater curvature supplied by the Gastroepiploic vessels. [106]

In 1970s, the use of pedunculated flaps of the transverse abdominis muscle, which showed good healing in the experimental animals.

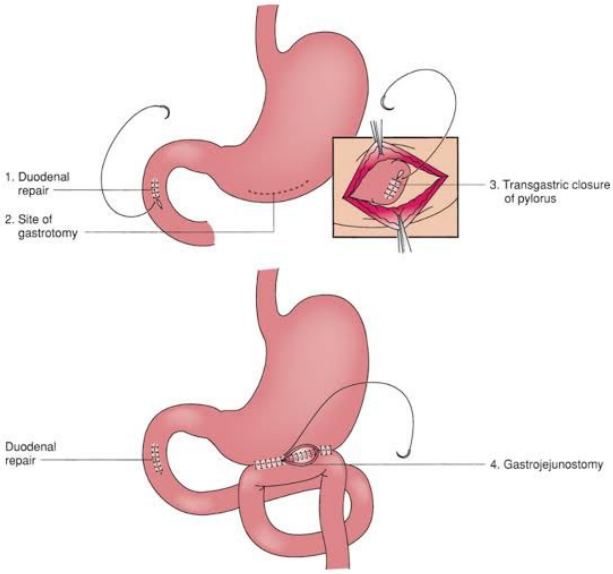
If the entire duodenal circumference is devitalised, a segmental resection and an end to end duodenal anastomosis can be done. The resection of the 1st, 3rd and 4th portions of duodenum is not associated with a high risk of vascular involvement. The limiting step of the resection of the 2nd part of duodenum is attributed to the arterial arcade with pancreas.

Patients with severe duodenal injuries are the candidates for the complex repair such as pyloric exclusion or Duodenal diverticulization procedures, like penetrating or blunt abdominal injury involving more than 75% of the wall, the 1st and 2nd parts of the duodenum, those associated with a delayed repair of more than 24 hours duration and associated bile duct or pancreatic injury. The

main purpose of these procedures is to exclude the passage of food contents from stomach passing through the duodenum, to prevent suture line dehiscence & to allow time for healing of the duodenal repair.

Pyloric Exclusion:

- Pyloric exclusion is a procedure in which the pylorus is closed for the purpose of excluding gastric secretions from the duodenal injury/ repair. It is done in intermediate &high-grade injuries. Following the duodenal repair, the pylorus isclosed through longitudinal antral gastrotomy using partial thickness absorbable or non-absorbable sutures placed proximally into the pylorus or alternatively using a noncutter linear stapler which is applied transversely just distal to the pylorus. Then for the diversion, Loop or Roux en Y Gastrojejunostomy is done.
- The pylorus will reopen spontaneously within 6- 8 weeks in majority of patients, even ifnon-absorbable sutures or staples are used. Although it is a straightforward procedure, it is associated with high incidence of marginal ulceration along the Gastrojejunostomy stoma.
- It has the advantage of preventing antral resection.



➢ Gastro-jejunostomy and pyloric exclusion for complex duodenal injury.

Duodenal Decompression:

- Following the repair of injury, the duodenum can be decompressed in an antegrade (Tube duodenostomy) or retrograde (Jejunostomy) fashion. This decreases the pressure and volume of secretions in the duodenum.
- To reinforce the duodenal repair with tube enterostomy, a serosal patch or mucosal graft from the jejunum or stomach have been used.

Duodenal Diverticulization:

The original duodenal diverticulization was described by Berne et al. [107] in 1968. This includes Gastric antrectomy and Gastrojejunostomy, Truncal vagotomy, wound excision and Duodenorraphy, Duodenostomy, Kehr's tube and feeding Jejunostomy. It is a complex &time-consuming procedure.

Combined Pancreaticoduodenal Injuries:

These are associated with a high risk for morbidity and mortality. If the pancreas and duodenal injuries are of low grade separately, they can be managed as separate procedures. If it is more extensive then chances of postoperative duodenal and pancreatic fistulasare high. For the patients with severe, combined pancreaticoduodenal injury, in which the Ampulla of Vater or intrapancreatic bile duct has been destroyed with devitalization of head of pancreas, reconstruction is impossible and resection is needed. A damage control approach is often needed due to other associated injuries, which necessitates staged procedure. [117,118]

Duodenopancreatectomy:

It is for complex duodenal injury & was first suggested by Thal and Wilson [108] in 1964. Indications to perform Whipples procedure include

- Massive, uncontrolled bleeding of the head of pancreas
- Bleeding from adjacent vascular structures
- Non reconstructible injuries in the duodenum
- Isolated or combined non reconstructible injuries in the pancreas- Head and common bile duct together with duodenum. [107]

The pancreaticoduodenectomy is done with the resection of Head of pancreas and the Duodenum. At the initial exploration, the pylorus, proximal jejunum and pancreatic stump are stapled and transected. The common bile duct is ligated or a drain is placed within it. The patient is stabilised in the ISCU and after 1-2 days, re surgery is done for reconstruction.

Iatrogenic Duodenal injury:

Duodenal injuries post endoscopic procedures such as Upper Gastrointestinal endoscopy and ERCP may present as bleeding from the Ampulla of Vater after endoscopic sphincterotomy,sometimes perforation also may occur. They warrant surgical repair occasionally.

MORBIDITY

Duodenal injuries are always associated with high morbidity rate with complications from fistula, suture line dehiscence to duodenal obstruction. Morbidity rate ranges from 22% in some studies to 64% in others.

Complications:

- Intraabdominal abscess: (11-18%)

  It is the most common complication.

  Fluid collections are managed with antibiotics.

  Abscess are drained by percutaneous guided aspiration or pigtail catheterisation.

- Duodenal fistula: (6-7%)

  It is the most life-threatening complication.

  Management consists of drainage to control the fistula output, drainage of associated fluid collections or abscess, broad spectrum antibiotics, fluid resuscitation and nutritional support.

  In cases of high output duodenal fistula, re-exploration should be performed, and pyloric exclusion should be considered if not previously performed.

- Post-traumatic Pancreatitis: (3-15%)

  It is managed conservatively with bowel rest, anti-secretory agents, fluid therapy and nutritional support.

- Pancreatic fistula: (5-37% in associated pancreatic injuries)

Management includes initial bowel rest, total parenteral nutrition, enteral nutrition (in low output pancreatic fistulas<20ml/day), octreotide infusion (in high output fistula with hypovolemia and electrolyte abnormalities), surgery in patients with persistent fistulas.

- Pancreatic pseudocyst: (30% in associated pancreatic injuries)

  Early management consists of percutaneous drainage of fluid collections and antibiotics.

  Late management includes ERCP and with pancreatic duct stenting, internal drainage, external drainage and resection.

- Rarely Duodenal obstruction.

MORTALITY

For duodenal injuries, half of the deaths are early, caused primarily by exsanguination/ bleeding from major vessels and haemorrhagic shock and half of the deaths are late due to complications including sepsis and Multiorgan failure. Overall mortality was 5.3% to 30%.

The important factors associated with mortality are associated injuries like other solid organ injuries, other system injuries and its complications, locally associated pancreatic & bile duct injuries. The most important factor is delay in the injury recognition and repair time. Synder et al., reported that there is 50% mortality in patients who undergone delayed surgery, with fistula formation in 50% of patients. Lucas and Ledgerwood in 1975 concluded that delay in diagnosis and treatment more than 1 day increases mortality from 11% to 40%.

According to the AAST-OIS classification

Grade	Mortality
I	8.3%
II	18.7%
III	27.6%
IV	30.8%
V	58.8%

MATERIALS AND METHODS

MATERIALS AND METHODS

Sample size	:	35 cases.
Study Design	:	Prospective (Observational study)
Study population	:	35 cases
Study period	:	May 2017 to September 2018
Study Centre	:	Rajiv Gandhi Government General Hospital & Madras medical college, Institute of General Surgery
Inclusion criteria	:	The patients admitted to various surgical wards in RGGGH with duodenal injuries.
Exclusion criteria	:	Children <17 years Pregnant women Patients with severe other system injury needing intervention for the same.
Assessment of Parameters	:	All the patients whofit the inclusion criteria will be observed and following data collected. Routine blood investigations like Total WBC count, Hb, Hct, ESR, Blood Urea, Creatinine, Coagulation profile, Blood Grouping & Typing, Liver Function Tests including Total Bilirubin, Direct/Indirect, SGOT, SGPT, ALP, Total protein, Albumin/Globulin, Serum Amylase & lipase, Serum Electrolytes.

Radiological investigations:

- X-rays
- FAST/ USG abdomen & Pelvis,
- CECT Abdomen and Pelvis
- MRCP
- ERCP reports
- OGD reports

Intra-Operative findings

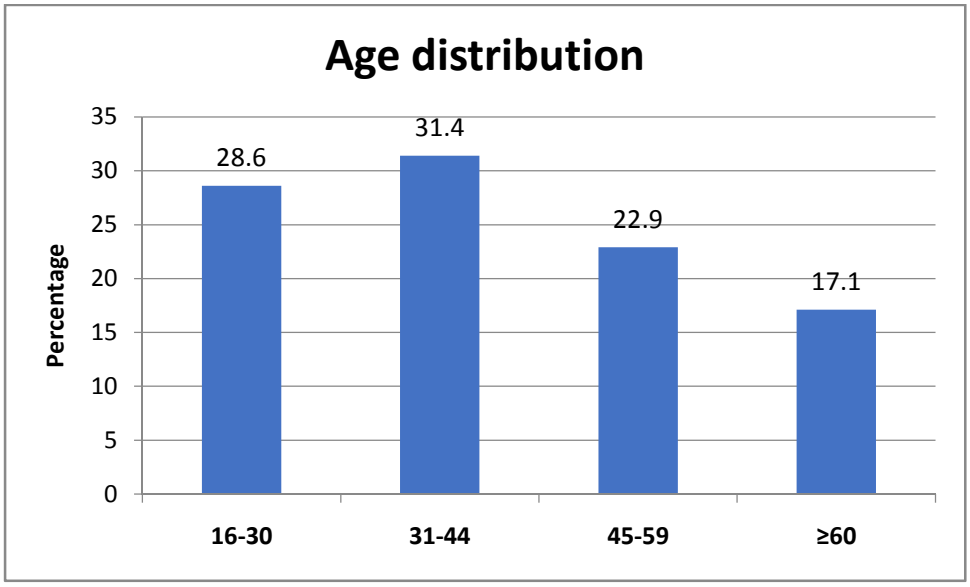
Postoperative Drain values, blood investigations and follow up investigations & procedures.

DATA ANALYSIS AND RESULTS

1. Age distribution of study participants

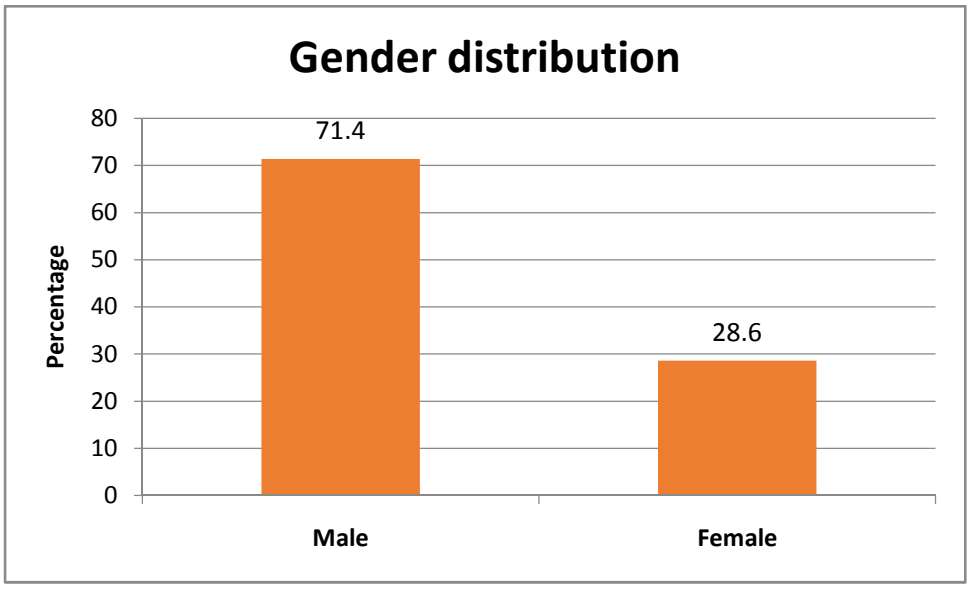
Mean and standard deviation of age was 41.5 (14.5) years.

Age groups	Number	Percentage
16-30	10	28.6
31-44	11	31.4
45-59	8	22.9
≥60	6	17.1
Total	35	100



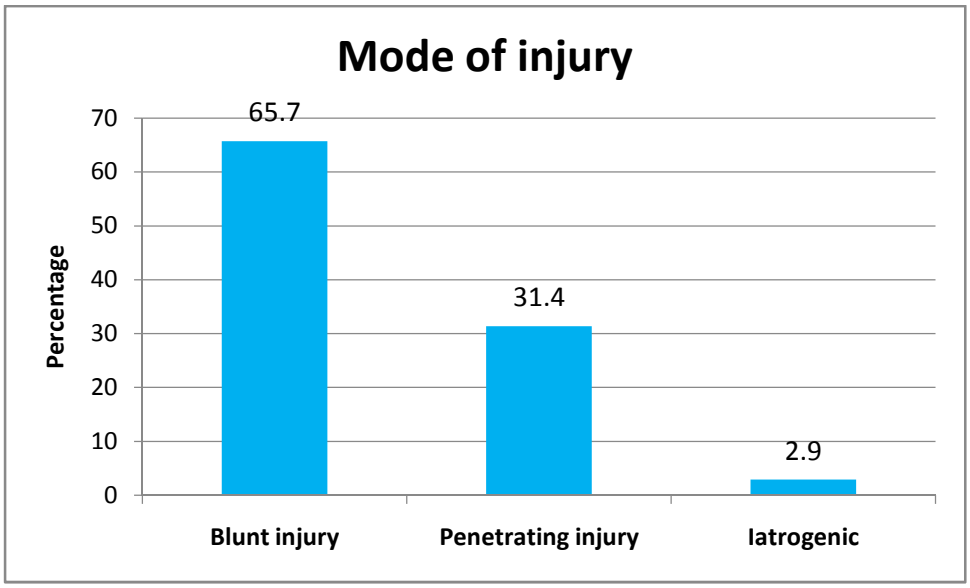
2. Gender distribution

Gender	Number	Percentage
Male	25	71.4
Female	10	28.6
Total	35	100



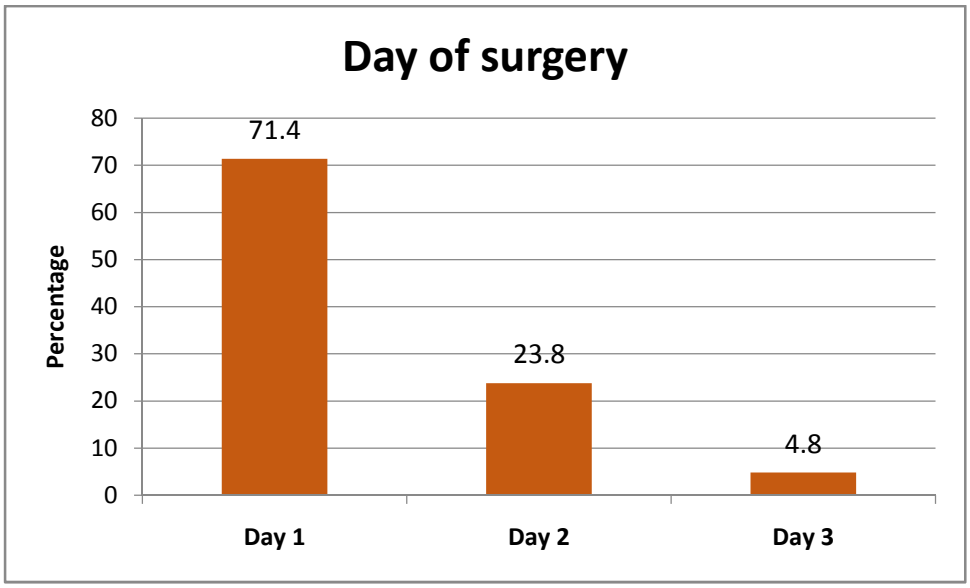
3. Mode of injury

Mode of injury	Number	Percentage
Blunt injury	23	65.7
Penetrating injury	11	31.4
Iatrogenic	1	2.9
Total	35	100



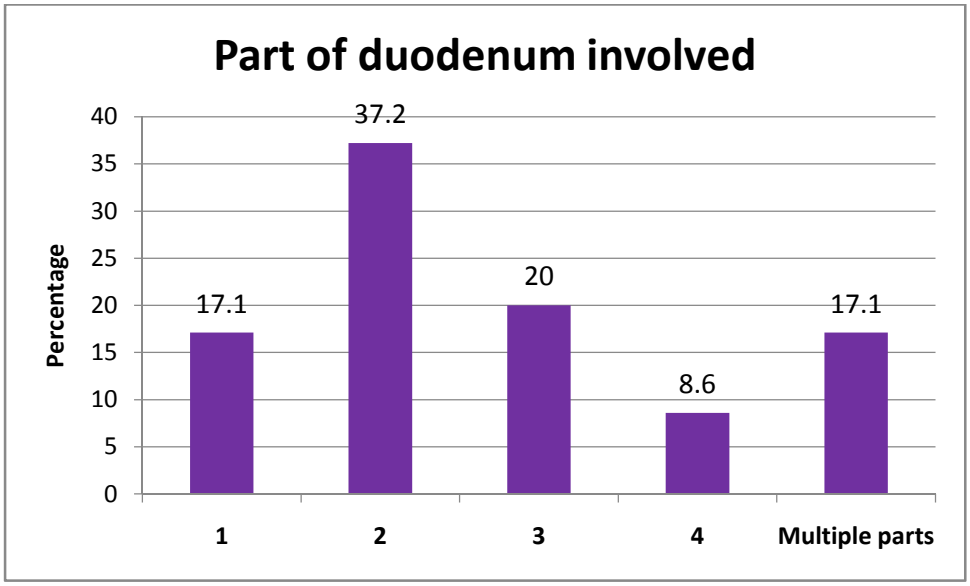
4. Day of surgery

Day of surgery	Number	Percentage
Day 1	15	71.4
Day 2	5	23.8
Day 3	1	4.8
Total	21	100



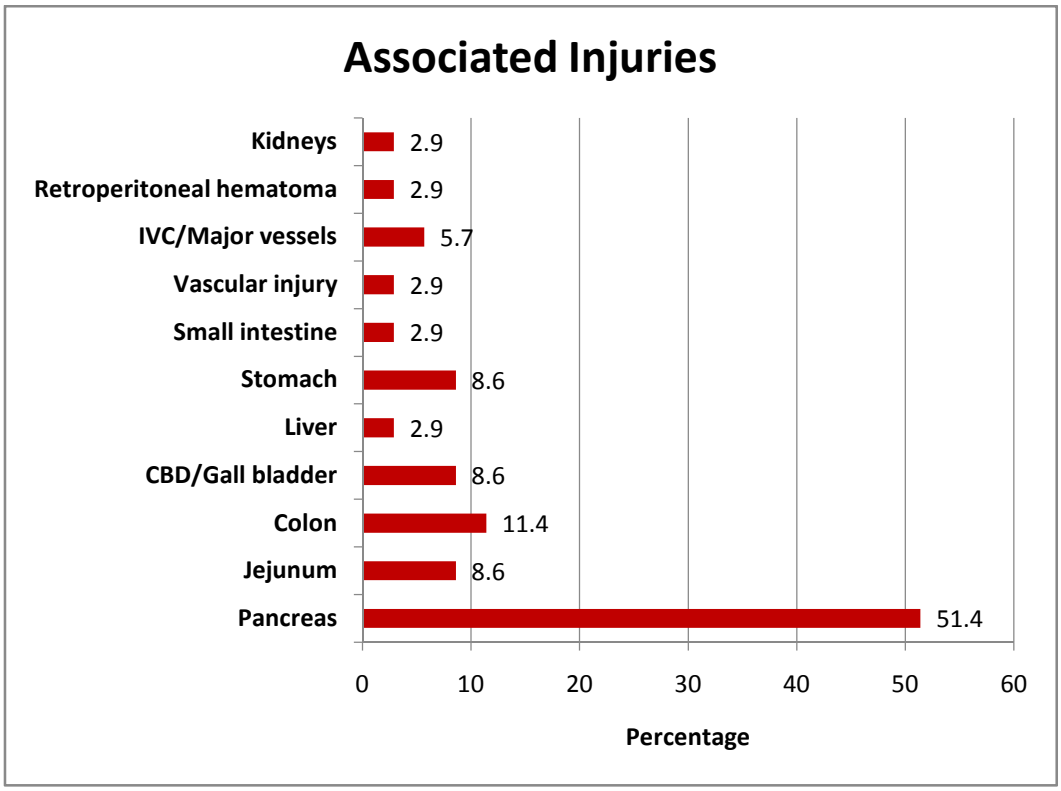
5. Part of duodenum involved

Part	Number	Percentage
1	6	17.1
2	13	37.2
3	7	20
4	3	8.6
Multiple parts	6	17.1
Total	35	100



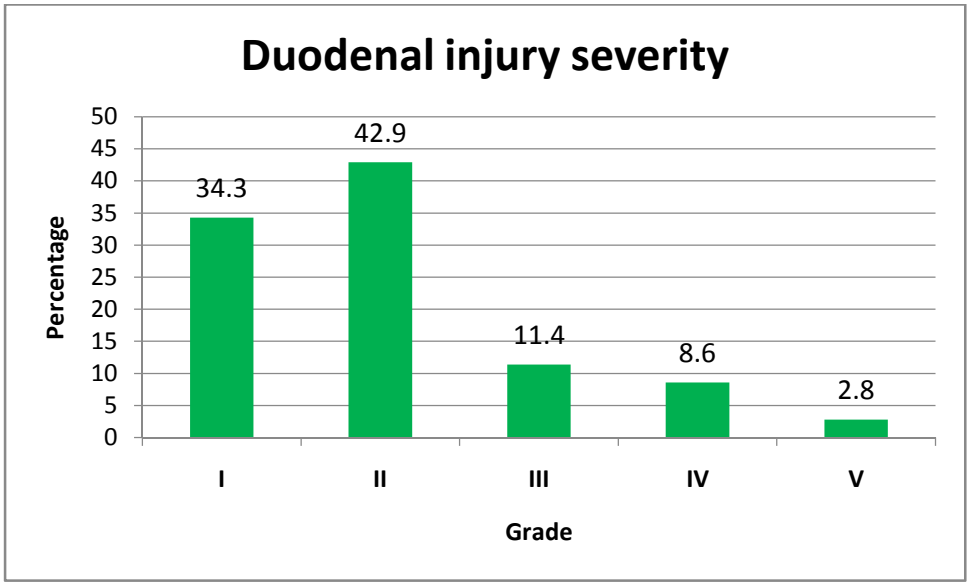
6. Associated injuries

Associated injuries	Number	Percentage
Pancreas	18	51.4
Jejunum	3	8.6
Colon	4	11.4
CBD/Gall bladder	3	8.6
Liver	1	2.9
Stomach	3	8.6
Small intestine	1	2.9
Vascular injury	1	2.9
IVC/Major vessels	2	5.7
Retroperitoneal hematoma	1	2.9
Kidneys	1	2.9
Total	35	



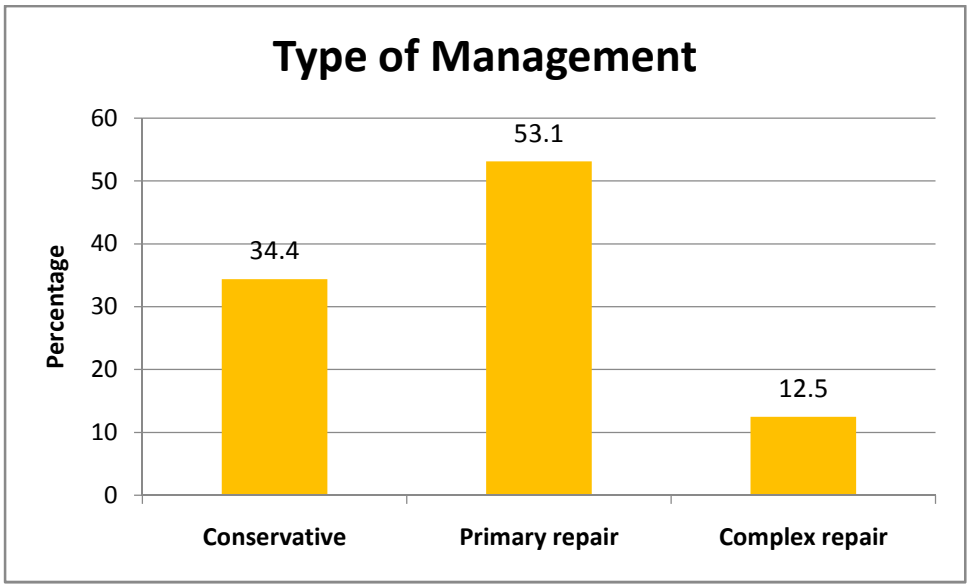
7. Duodenal injury severity

Grade	Number	Percentage
I	12	34.3
II	15	42.9
III	4	11.4
IV	3	8.6
V	1	2.8
Total	35	100



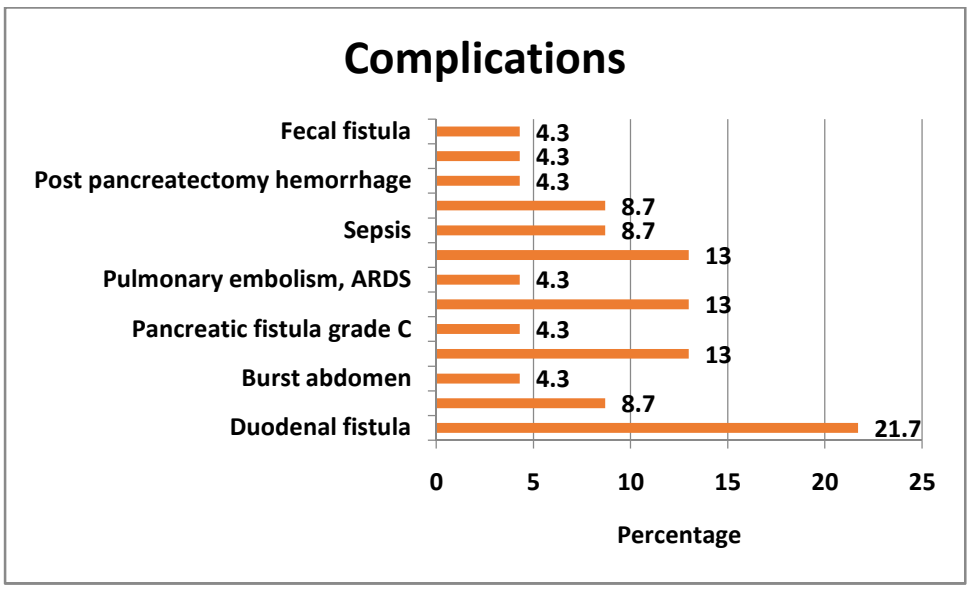
8. Type of surgery

Management	Number	Percentage
Conservative	11	34.4
Primary repair	17	53.1
Complex repair	4	12.5
Total	32	100



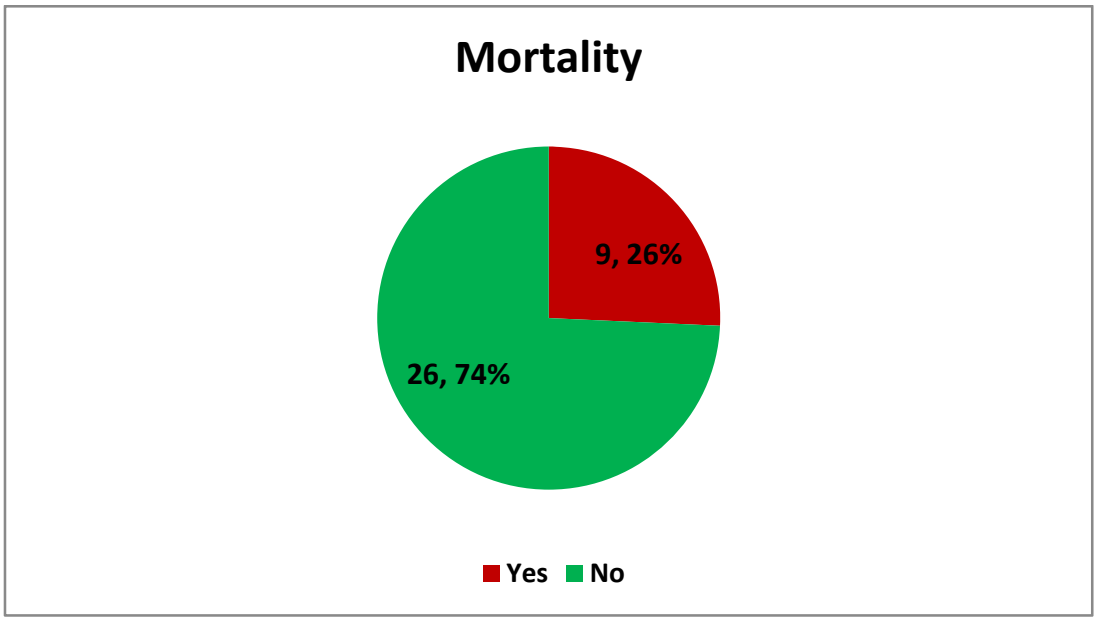
9. Type of complications (n-23)

Complications (n=23)	Number	Percentage
Duodenal fistula	5	21.7
Biliary fistula	2	8.7
Burst abdomen	1	4.3
Pneumonia	3	13.0
Pancreatic fistula grade C	1	4.3
Pancreatitis	3	13.0
Pulmonary embolism, ARDS	1	4.3
Hypotension	3	13.0
Sepsis	2	8.7
MODS	2	8.7
Post pancreatectomy hemorrhage	1	4.3
DVT	1	4.3
Fecal fistula	1	4.3



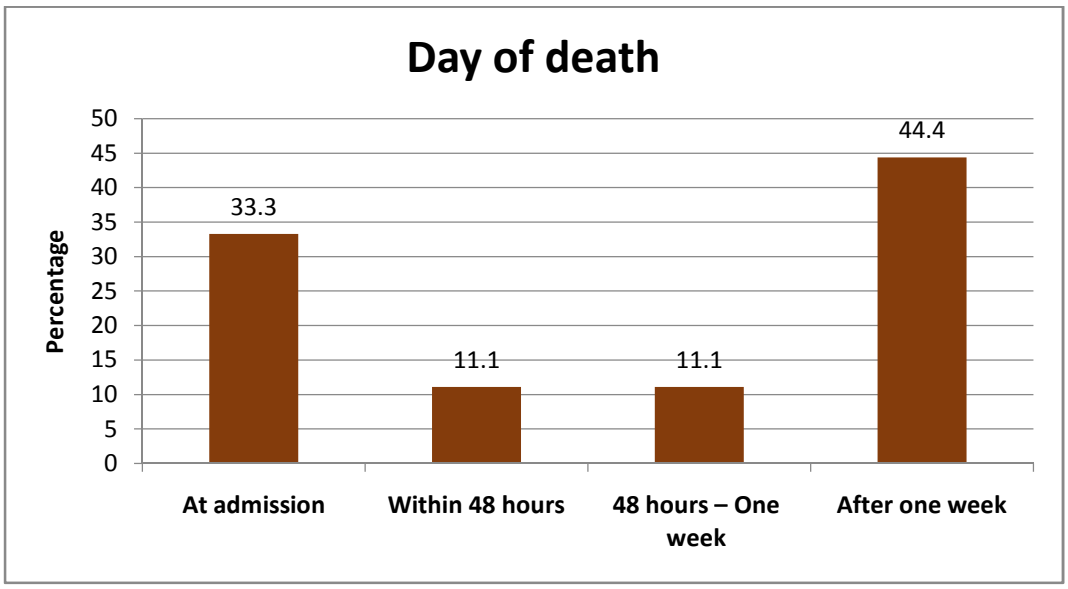
10. Mortality

Mortality	Number	Percentage
Yes	9	25.7
No	26	74.3
Total	35	100



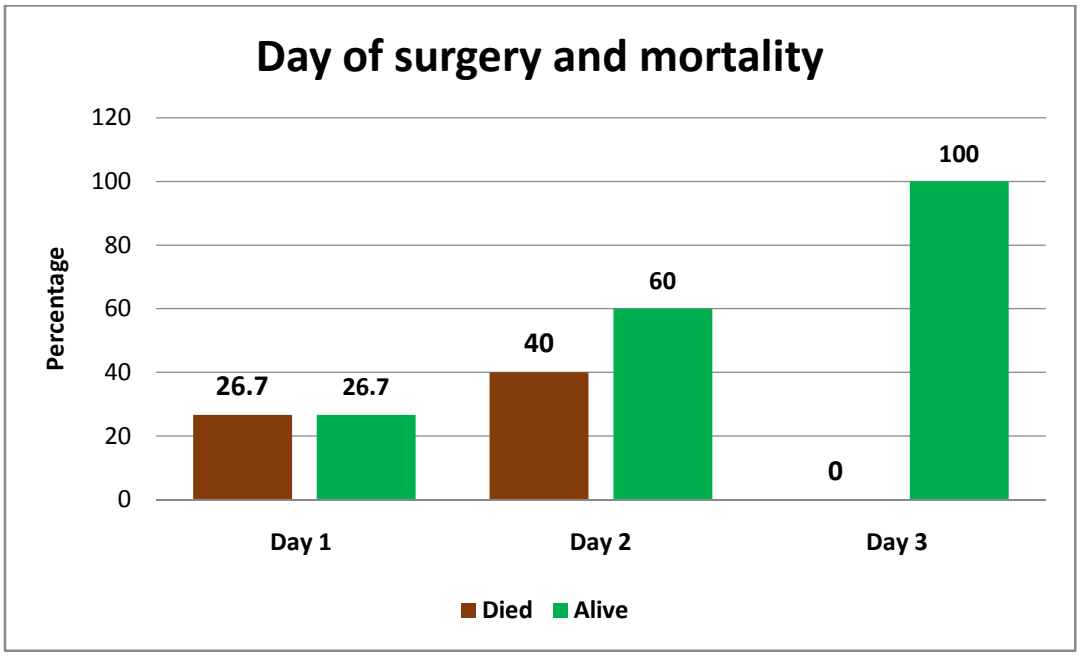
11. Day of death

Day of death (n=9)	Number	Percentage
At admission	3	33.3
Within 48 hours	1	11.1
48 hours – One week	1	11.1
After one week	4	44.4
Total	9	100



.12. Day of surgery and mortality

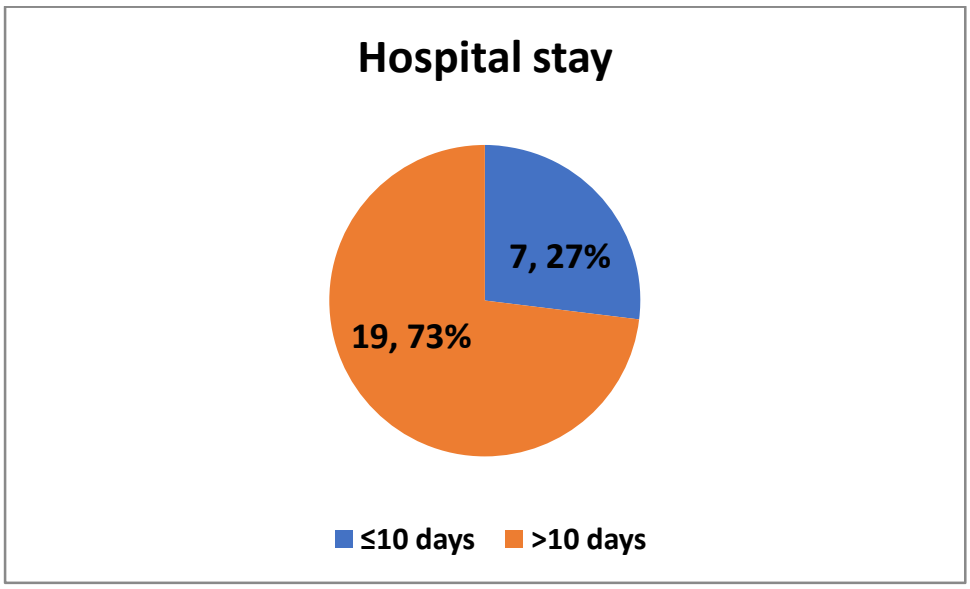
Day of surgery	Died n (%)	Alive n (%)	Total
1	4 (26.7)	11 (73.3)	15
2	2 (40.0)	3 (60.0)	5
3	0 (0)	1 (100.0)	1
Total	6	15	21
Chi square value=0.75			



13. Hospital stay of patients

Average hospitalstay(n=26) was 14.3 days with standard deviation of 4.3 days. Range was 8 days to 25 days.

Hospital stay (n=9)	Number	Percentage
≤10 days	7	26.9
>10 days	19	73.1
Total	26	100



DISCUSSION

DISCUSSION

Management of Duodenal injuries is a challenging problem due to its difficult diagnosis and complex treatment. CT of the abdomen preoperatively is the choice of investigation in patients with subtle signs.Repeated CT should be done for patients in stable condition with signs of duodenal injury post conservative management. Most of the injuries are diagnosed intraoperatively following emergency laparotomies. Depending upon the grading and severity of the duodenal injury, it is managed from simple repair to triple ostomies and Whipples procedure for higher grade. Every patient with duodenal injury needs a technically demanding and time-consuming procedures.

Surgical management of duodenal lacerations hinges on the extent and severity of the duodenal injury, as well as the involvement of adjacent vasculature, biliary tree, and pancreas. Uncomplicated duodenal lacerations are repaired by Simple primary repair such as simple seromuscular Lembert suture or Duodenorraphy is an adequate method. If there is a risk of luminal narrowing post primary repair, then resection of the injured duodenum is warranted. In grade II, III or IV injuries, pedicled mucosal graft, jejunal serosal patches, omental patches, pyloric exclusion procedure and Roux en Y reconstruction can be done.

Primary repair with Tube Duodenostomy is an alternative & safe option for the complex cases with a protection against the wound dehiscence. Lower duodenal injuries on D3 & D4 are treated similar to the small bowel injuries.

In haemodynamically unstable patients, a damage control surgery should be done to avoid early deaths and postoperative complications and mortality.

The National Trauma Data Bank identified and collected data from patients with chest and head Abbreviated Injury Scale <3 & nonduodenal intraabdominal organ injury scale >3. Overall, 1% of patients with abdominal trauma had Duodenal injury with isolated Duodenal injury being only 0.6%. The majority of Isolated Duodenal injury is low grade. The patients with severe isolated duodenal injury had 5.2% mortality rate. Of 47.5% of patients with duodenal injury operated, 37.7% had primary repair and 9.2% had complex repair. Hospital length of stay is of average 11 days for primary repair & 18 days for complex repair.

RECOMMENDATIONS

- Traumatic duodenal injury occurs in 3 to 5% of the patients with blunt injury abdomen presenting to the emergency departments.
- Greater the severity and delay in diagnosis leads to increase in morbidity and mortality.
- Since most of the Duodenum is situated retroperitoneally, signs and symptoms are very subtle and missed during routine screening X rays and FAST.
- The diagnosis of these low-grade injuries can be challenging & needs proper observation of the patient together with CT scans.
- CT is the best imaging technique for the Duodenal injuries. IV and Oral contrast studies have a better visualisation of the Duodenal injuries.
- Low grade blunt abdominal injuries that fall into Grade I & II(in selected patients) are managed conservatively than exploratory laparotomy and repair. Only about 10% of these patients will require surgical intervention on follow-up.
- Conservatively managed patients should be taken care nutritionally with TPN or enteral nutrition by FJ. Fluid and electrolyte abnormalities are also addressed properly.
- Penetrating injury of any grade should be explored and treated accordingly.
- In intermediate & high-grade injuries surgical exploration is mandatory and relatively simple surgical techniques are often needed. It includes thorough debridement, local repair of lacerations, closed suction drains.

Resection and anastomosis for the full thickness injury and Grade V injuries.

- For associated pancreatic injuries: distal pancreatic injuries involving pancreatic duct are managed by Distal pancreatectomy. Proximal pancreatic injury of low grade is managed by closed suction drainage.
- High grade Pancreatic head injuries are treated by Whipples procedure, which has higher morbidity and mortality rates.
- High grade injuries are managed by damage control approach & interval procedures are often advised than definitive procedure at the same sitting.
- Mortality following the Duodenal injuries will be 15-25% and is related to the severity of the duodenal injuries, pancreatic and other organ injuries.
- Complications are common and include intra-abdominal abscess, Duodenal fistula, biliary fistula, pneumonia, pancreatitis, pancreatic pseudocyst, pulmonary embolism, Deep vein thrombosis, ARDS, Sepsis, MODS, post pancreatectomy haemorrhage, faecal fistula, etc.,

CONCLUSION

Duodenal injuries present as simple hematomas, perforation and combined pancreaticoduodenal injuries. The majority of duodenal hematomas are managed conservatively with nasogastric suction and parenteral nutrition. Patients with suspected associated perforation, suggested by clinical deterioration or imaging with retroperitoneal free air or contrast extravasation, should undergo operative exploratory laparotomy. A marked drop in the nasogastric tube output heralds resolution of the hematoma, which typically occurs within the period of 2 weeks. Repeat imaging should be done to prove the findings. If the patient shows no clinical or radiological improvements within 3 weeks, operative intervention is needed.

Low grade duodenal injuries are treated by primary repair with running, single layer 3-0 monofilament. The wound should be closed in the direction that results in the larger luminal diameter. When there is substantial loss of duodenal tissue, complex repair is done. Extensive injuries to the 1st partof the duodenum (proximal to the Ampulla of Vater) can be repaired by debridement and end to end anastomosis because of rich blood supply & good mobility.

The 2nd part of duodenum is tethered to the head of pancreas by its blood supply and Ducts of Santorini &Wirsung.Therefore no more than 1 cm of duodenum can be mobilised away from the pancreas, and this does not effectively alleviate tension on the suture line. Defects in the 2nd part of duodenum should be patched with a vascularised graft from jejunum or gastric body. Duodenal injuries distal to the ampulla of Vater and proximal to the superior mesenteric vessels are best treated by Roux- en- Y duodenojejunostomy with the distal portion of the duodenum is over sewn.

In injuries to the 3rd& 4th parts of duodenum, the injured segments are resected and a duodenojejunostomy is performed on the left side of superior mesenteric vessels.

For high grade pancreaticoduodenal injuries, Whipples procedure is done. Pyloric exclusion is often used to divert the GI stream after high risk, complex duodenal repairs. If duodenal repair breaks down, the resultant fistula is end fistula, which is easier to manage and more likely to close rather than a lateral fistula.

Complications after major pancreaticoduodenal injuries are more common. Duodenal fistula, if presumptively an end fistula following pyloric exclusion, will typically heal in 6 to 8 weeks with adequate drainage and control of intra-abdominal infection. Intra-abdominal abscesses are common and are managed by higher broad-spectrum antibiotics and percutaneous drainage.

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ANNEXURES

PATIENT PROFORMA

Name:	IP No.:
Age:	Unit:
Sex:	Date of Admission:
Occupation:	Date of Surgery:
Address:	Date of Discharge/Death:

Complaints:

Alleged history of RTA/Accidental fall/Assault/Fall from height/etc., around___ time, ___ place, on ____ date of incident.

History of treatment at ____ hospital & reason for referral___.

History of Head/Neck/Chest/Extremity injury

History of Abdomen& Pelvis injury

History of Genitalia injury & injuries to the back

Hx of Loss of consciousness/ vomiting/ seizures/ ear, nose, throat bleeding

Hx of Presenting Illness:

Hx of Abdominal pain

- Duration
- Site
- Mode of onset
- Character
- Shifting of pain
- Referral/ radiation of pain
- Aggrevating/ relieving factors

Hx of Nausea and Vomiting

Hx of Haematemesis/ Malena

Hx of Abdominal distension

Hx of Jaundice

Hx of fever

Hx of Haematuria/ high coloured urine

Hx of Chest pain/ breathlessness

Past Hx:

Hx of Co-morbid illnesses

Hx of any previous hospital admissions

Hx of any previous surgery

Hx of drug allergy

Personal Hx:

Diet

Drug abuse

Mental illness

Exposure to STD's

General Examination

O/E,

Consciousness

Orientation,

GCS

Built & Nourishment

Hydration

Pallor, cyanosis, clubbing, icterus, pedal edema& generalised lymphadenopathy

Vitals:

Pulse Rate

Blood Pressure

Respiratory Rate

Abdominal Girth

Random Blood Sugar

Saturation

System Examination:

CVS- S1 S2, added sounds

RS- B/L air entry, added sounds

P/A

Inspection:

- Abdomen sunken/flat/distended
- Umbilicus position
- Movements of quadrants with respiration
- Any scars/ sinuses/ dilated veins
- Any external injuries/ contusion/ ecchymosis
- Any VIP/ VGP
- Any mass/ visible pulsation
- Hernial orifices
- External genitalia
- B/L flanks
- Back

Palpation:

- Warmth
- Tenderness
- Mass
- Hepatosplenomegaly/ Organomegaly
- Guarding or rigidity

Percussion:

- Shifting dullness/ free fluid
- Rebound tenderness
- Liver span

Auscultation:

- Bowel sounds
- Bruit

P/V in females:

Digital Rectal Examination:

For any collection/ tenderness.

Blood investigations:

TC		RBS		Total Bilirubin	
Hb		Urea		Direct/Indirect	
HCT		Creatinine		SGOT	
DC		Na+		SGPT	
Platelets		K+		ALP	
HIV		Amylase		Total Protein	
HBsAg/HCV		Lipase		Albumin	

Coagulation profile

ABGA

Radiological investigations:

1. X ray Chest and Abdomen
2. FAST
3. USG Abdomen & Pelvis
4. CECT Abdomen & Pelvis with IV & Oral contrast
5. MRCP if needed

Diagnosis:

Intraoperative findings:

Postoperative follow up:

INFORMATION SHEET

We are conducting a study on" COMPREHENSIVE MANAGEMENT OF DUODENAL INJURIES & ITS OUTCOME"

among patients attending Rajiv Gandhi Government General Hospital, Chennai and for that your information is valuable to us.

The purpose of this study is to assess the magnitude of problem and evaluate and reduce the morbidity in patients with appendicular mass and abscess at RGGGH,Chennai.

We are selecting certain cases and if you are found eligible, we may be using your information which in any way do not affect your final report or management.

The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.

The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of the Participant

Signature of the Investigator

Date

Place

PATIENT CONSENT FORM

STUDY TITLE:

"COMPREHENSIVE MANAGEMENT OF DUODENAL INJURIES & ITS OUTCOME"

STUDY CENTRE:

Rajiv Gandhi Government General hospital and Madras Medical College.

PARTICIPANT NAME: AGE: SEX: I.P. NO :

I confirm that I have understood the purpose of interventional procedure for the above study. I have the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the possible complications that may occur during the interventional and interventional procedure. I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving any reason.

I understand that the investigator, regulatory authorities and the ethics committee will not need my permission to look at my health records both in respect to the current study and any further research that may be conducted in relation to it, even if I withdraw from the study. I understand that my identity will not be revealed in any information released to third parties or published,

unless as required under the law. I agree not to restrict the use of any data or results that arise from the study.

I hereby consent to participate in this study of the COMPHREHENSIVE MANAGEMENT OF DUODENAL INJURIES & ITS OUTCOME

Date: signature / thumb impression of patient

Place:

Patient's name:

Signature of the Investigator: _____

Name of the investigator:

ஆராய்ச்சியில் பங்கேற்பவர்கான தகவல் அறிக்கை

ஆராய்ச்சி தலைப்பு

முன் சிறுகுடல்/ சிறுகுடல்வாய் காயங்களின் விரிவான மேலாண்மை மற்றும் அதன் விளைவுகளின் ஓர் ஆய்வு

பங்கு கொள்பவரின் பெயர் :

ஆராய்ச்சி செய்பவரின் பெயர் : மரு.ந.மோகனசுந்தரம்

இடம் : இராஜீவ்காந்தி அரசு பொது மருத்துவமனை,
சென்னை-3.

இந்த ஆராய்ச்சி/ஆய்வு/ செய்முறை/சோதனையில் தாங்கள் பங்கேற்க அழைக்கிறோம். இந்த தகவல் அறிக்கையில் கூறப்பட்டிருக்கும் தகவல்கள் தாங்கள் இந்த ஆராய்ச்சியில் பங்கேற்கலாமா வேண்டாமா என்பதை முடிவு செய்ய உதவியாக இருக்கும். இந்த படிவத்தில் உள்ள தகவல்கள் பற்றி உள்ள சந்தேகங்களை நீங்கள் தயங்காமல் கேட்கலாம்.

இந்த ஆய்வின் நோக்கம் என்ன?

முன் சிறுகுடல்/ சிறுகுடல்வாய் காயங்களின் விரிவான மேலாண்மை மற்றும் அதன் விளைவுகள் பற்றி ஆய்வு மேற்கொள்ளப்படும்.

ஆய்வு முறைகள்

முன் சிறுகுடல்/ சிறுகுடல்வாய் காயங்களினால் பாதிக்கப்பட்ட நோயாளிகளிடம் அதற்கு சம்பந்தப்பட்ட தகவல்கள் மற்றும் வழக்கமான இரத்தப் பரிசோதனை மற்றும் பல்வேறு ஸ்கேன்கள் எடுக்கப்படும். அவர்கள் அறுவை சிகிச்சை மூலம் அவை சரிசெய்ய முற்படும்.

ஆய்வினால் நோயாளிக்கு ஏற்படும் நன்மைகள்

இந்த ஆய்வின் முடிவில் கிடைக்கும் தகவல்கள் சமுதாயத்திற்கு பயனுள்ளதாகவும், எதிர்காலத்தில் நோயாளிகளுக்கு மருத்துவ தீர்வாகவும் அமையும்

ஆய்வினால் மருத்துவருக்கு ஏற்படும் நன்மைகள்

மருத்துவர் நோயின் தன்மையை தேர்வு செய்யவும் அதன் பயனை நோயாளிக்கு எடுத்து உறைக்கவும் பயன்படும்.

தங்களிடமிருந்து பெறப்படும் தகவல்களின் நம்பகத்தன்மை

தங்களிடமிருந்து பெறப்படும் தகவல்கள் பாதுகாக்கப்படுவதற்கான முழு உரிமையும் தங்களுக்கு உண்டு.

இந்த படிவத்தில் கையொப்பமிடுவதன் மூலம், தாங்கள் தங்களை பற்றிய விவரங்களையும், ஆய்வு விவரங்களையும் ஆராய்சியாளர், ஆய்வு நடத்தும் ஏனையோர் வரைமுறை ஒழுங்கு குழுவினர் மற்றும் சட்டத்திற்கு உட்பட்ட மருந்து கட்டுப்பாடு இயக்குநர் ஆகியோர் பார்வையிட அனுமதிக்கின்றீர்கள்.

இந்த ஆய்வில் காட்டப்படும் தகவல்கள் அறிவியல் நாளேடுகளிலோ அறிவியல் கூட்டங்களிலோ சமர்ப்பிக்கப்படும் பட்சத்தில் தங்களது அடையாளம் வெளிப்படுத்தப்படமாட்டாது.

இந்த ஆய்வில் பங்கேற்காமல் இருப்பதனால் ஏற்படும் பாதிப்பு

இந்த ஆய்வில் தாங்கள் பங்கேற்க விருப்பம் தெரிவிக்காத நிலையில் தங்களின் மருத்துவர் மற்றும் மருத்துவமனையில் தங்களுக்கு உள்ள உறவில் எந்த பாதிப்பும் ஏற்படாது. தாங்கள் சிறப்பாக கவனிக்கப்படுவீர்கள். மேலும் இதனால் தங்களுக்கு இழப்பு ஏதும் ஏற்படாது.

ஆய்வின் நடுவில் அதிலிருந்து விலகிகி கொள்ள நினைத்தால்

இந்த ஆய்வில் பங்கேற்பது தங்களின் சொந்த விருப்பமே. மேலும் ஆய்வின் நடுவில் எந்த நேரத்திலும், எக்காரணமும் கூறாமல் விலகிக் கொள்ள தங்களுக்கு முழு உரிமை உண்டு. இருப்பினும் ஆய்விலிருந்து விலகுவதற்கு முன் ஆராய்ச்சி குழுவுடன் கலந்து ஆலோசிப்பது உகந்தது என பரிந்துரைக்கப்படுகிறது.

ஆராய்ச்சியாளர் கையொப்பம் **பங்கேற்பாளர் கையொப்பம்**

தேதி: தேதி :

ஆராய்ச்சி ஒப்புதல் படிவம்

ஆராய்ச்சியின் தலைப்பு:

முன் சிறுகுடல்/ சிறுகுடல்வாய் காயங்களின் விரிவான மேலாண்மை மற்றும் அதன் விளைவுகளின் ஓர் ஆய்வு

ஆராய்ச்சி செய்பவரின் பெயர் : மரு.ந.மோகனசுந்தரம்

ஆராய்ச்சி மையம் : ராஜீவ் காந்தி அரசு பொது மருத்துவமனை, சென்னை-600 003.

..... எனும் நான், எனக்கு கொடுத்துள்ள தகவல் தாளை படித்து புரிந்து கொண்டேன். நான் பதினெட்டு வயதை கடந்துள்ளதால், என்னுடைய சுய நினைவுடனும், முழு சுதந்திரத்துடனும், இந்த ஆராய்ச்சியில் என்னை சேர்த்துக கொள்ள சம்மதிக்கிறேன்.

1) நான் எனக்கு அளிக்கப்பட்ட ஒப்புதல் படிவத்தையும் தகவல்களையும் படித்து புரிந்துகொண்டேன்.

2) ஒப்புதல் படிவத்தில் உள்ள தகவல்கள் எனக்கு விளக்கிக் கூறப்பட்டன

3) ஆய்வின் தன்மை பற்றி எனக்கு விளக்கப்பட்டது.

4) என்னுடைய உரிமைகளையும், பொறுப்புகளையும் ஆராய்ச்சியாளர் விளக்கிக் கூறினார்.

5) நான் ஆராய்ச்சியாளருடன் ஒத்துழைப்பேன் என்றும் எனக்கு ஏற்படக்கூடிய அசாதாரணமான நிகழ்வுகள் பற்றியும் உடனடியாக ஆராய்ச்சியாளரிடம் தெரிவிப்பேன் என்று உறுதி கூறுகிறேன்.

6) நான் கடந்த ..... மாதங்களாக வேறு எந்தவிதமான ஆய்வுகளிலும் பங்கேற்கவில்லை.

7) எனக்கு செய்யப்படும் அனைத்து பரிசோதனைகளும் (உதாரணம்: இரத்தம் எடுத்தல்) என நோயின் தன்மையை அறிவதற்காக செய்யப்படுபவை என்பதை அறிகிறேன்

8) இந்த ஆய்விலிருந்து எப்போது வேண்டுமானாலும் எக்காரணமும் கூறாமல் என்னை விடுவித்துக் கொள்ளலாம் என்பதை அறிவேன். மற்றும் இதனால் எனக்குத் தரப்படும் சிகிச்சைக்கு எந்த பாதிப்பும் வராது என்பதை அறிவேன்.

9) ஆராய்ச்சியாளர்கள் இந்த ஆய்வில் எனது பங்களிப்பை எந்த நேரத்திலும், எக்காரணமும் கூறாமல் என் சம்மதம் இல்லாமலும் என்னை விலக்கிவிட முடியும் என்பதை அறிவேன்.

10) என்னிடம் இருந்து பெறப்படும் தகவல்களை அரசு, வரைமுறை அதிகாரிகள் ஆகியோர்களுடன் பகிர்ந்து கொள்ள ஆராய்ச்சியாளர்களுக்கு அனுமதி அளிக்கிறேன். என்னுடைய தஸ்தாவேஜுக்களை பார்வையிட அவர்களுக்கு உரிமை உண்டு.

11) என்னிடம் பெறப்படும் தகவல்களை பொதுவாக பிரசுரிக்கப்பட்டால், என்னுடைய அடையாளம் இரகசியமாக வைக்கப்படும் என்பதை அறிவேன்.

12) இந்த ஆராய்ச்சியில் பங்கேற்க தன்னிச்சையாக முழு மனதுடன் நான் சம்மதிக்கிறேன்.

இந்த ஆய்வின் போது எனக்கு என்ன சந்தேகம் ஏற்பட்டாலும் ஆராய்ச்சியாளரை தொடர்பு கொள்ளலாம் என்பதை அறிவேன். இந்த ஒப்புதல் படிவத்தில் கையெழுத்திடுவது மூலம் இங்கு தரப்பட்டிருக்கும் அனைத்து தகவல்களும் தெளிவாக கூறப்பட்டு என்னால் முபமையாக புரிந்து கொள்ளப்பட்டது என்பதை சான்றளிக்கிறேன். இந்த ஒப்புதல் படிவத்தின் நகல் என்னால் பெற்றுக் கொள்ளப்பட்டது.

பங்கேற்பவரின் கையொப்பம்: இடம்:

கட்டை விரல் ரேகை: தேதி:

பங்கேற்பவரின் பெயர்:

ஆய்வாளரின் பெயர்:

இடம்:
தேதி:

S no	name	age	sex	Op no	Mode of injury	Day of Surgery	Part of Duode num	Associated Injury	grade	Surgery	Complications	Death	Discharge
1	Gowri	25	F	54437	RTA/Blunt injury abdomen		1,2	Pancreas	1	Conservative	pancreatitis		8
2	Javiyar	34	M	72957	RTA/Poly trauma	1	1	Stomach	2	primary repair of stomach & duodenum	hypotension	1st POD	
3	Loganathan	32	M	37381	RTA/Blunt injury abdomen	1	2,3	Liver, Pancreas	4	Whipples procedure	Pancreatic fistula grade C	5th	
4	Ragini	65	F	45557	RTA/Blunt injury abdomen	2	2	Pancreas	2	Primary repair with tube duodenostomy	Duodenal fistula		17
5	Murugan	27	M	50724	Assault/stab injury	1	1	Stomach, IVC tear	2	omental patch closure of Duodenum, primary repair of stomach &IVC	Pulmonary embolism, ARDS	10th POD	
6	Mohan raj	42	M	119978	Assault/Penetrating injury	1	4	Jejunum at DJF	2	primary repair and tube duodenostomy & feeding jejunostomy			15
7	Sivashankar	21	M	102290	Fall from height/ Blunt injury	1	2,3	Pancreas, CBD	4	Whipples procedure	Post pancreatectomy haemorrhage	8th POD	
8	Kanniammal	60	F	64482	RTA/Blunt injury abdomen	2	2	Pancreas	5	Whipples procedure	Sepsis, MODS	12th	
9	Vijaya	52	F	64403	RTA/Blunt injury abdomen		2	Pancreas	3		hypotension	On admission	
10	Raja	25	M	59722	Iatrogenic post ERCP	3	2		2	primary repair with tube duodenostomy & feeding jejunostomy	Duodenal fistula		16
11	Amala	16	F	57570	Assault/Penetrating injury	1	1	Colon	3	Primary repair, pyloric exclusion , TD, GJ& feeding jejunostomy	Duodenal fistula		22
12	Alamelu	28	F	33610	Fall from height/ Blunt injury		2	Pancreas, vascular injury	4		Hypotension	On admission	
13	Rekha	26	F	48088	RTA/Blunt injury abdomen	1	3	Pancreas	2	primary repair with tube duodenostomy	Pneumonia		15
14	Velvizhi	54	F	47447	Assault/Penetrating injury	1	1,2	Colon	2	DJ, Pyloric exclusion , TD, GJ & feeding jejunostomy, Primary repair of colon	Faecal fistula		20
15	Jagannathan	60	M	49310	RTA/Blunt injury abdomen	2	2	Pancreas	3	primary repair with tube duodenostomy, Pyloric exclusion, GJ, FJ	Duodenal fistula, DVT, Sepsis, MODS	16th POD	
16	Jayavel	56	M	44620	Fall from height/ Blunt injury	1	1		2	Gastroduodenostomy			10
17	Thanikachalam	55	M	44411	Fall from height/ Blunt injury		3	retroperitoneal haematoma	1	Conservative			8

18	Kumar	40	M	36266	Assault/Penetrating injury	1	4	Jejunum, colon	2	primary repair with retrograde TD, FJ, primary repair jejunum, colon	Burst abdomen		25
19	Sundar	34	M	30954	RTA/Blunt injury abdomen	2	2	Pancreas	1	Primary repair	Pancreatitis		16
20	Krishnan	63	M	31051	Fall from height/ Blunt injury		3		1	Conservative	Biliary fistula		18
21	Saravanan	38	M	28268	Accidental fall/ Penetrating injury	1	2	gall bladder and CBD	2	Primary repair with tube duodenostomy, cholecystectomy, CholedochoJejunostomy	Duodenal fistula		17
22	Bituban	23	M	12963	RTA/Blunt injury abdomen	1	3,4	Jejunum	2	Primary repair of jejunum, duodenum primary repair, Retrograde TD with feeding jejunostomy	Pneumonia		15
23	Biresh	22	M	26379	RTA/Blunt injury abdomen		3	Pancreas	1	conservative			9
24	Settu	65	M	24918	Accidental fall/ Penetrating injury	2	2	CBD, Pancreas	2	Primary repair with tube duodenostomy, cholecystectomy, T tube drainage	Biliary fistula		14
25	Suguna	30	F	27900	Fall from height/ Blunt injury		4	Pancreas	1	conservative			11
26	Kandhasamy	56	M	152841	Accidental fall/ Penetrating injury	1	1		2	primary repair with tube duodenostomy with FJ			13
27	Kumar	48	M	69154	Fall from height/ Blunt injury		3	Right kidney, Pancreas	1	conservative			10
28	Chandran	40	M	110436	RTA/Blunt injury abdomen		3	Pancreas	1	Conservative	Pancreatitis		14
29	Glory	35	F	50057	Accidental fall/ Penetrating injury	1	2	Pancreas	2	primary repair , TD , with feeding jejunostomy	Duodenal fistula		16
30	Arul	37	M	52856	Assault/Penetrating injury	1	1	Stomach	2	primary repair with tube duodenostomy & feeding jejunostomy			18
31	Basha	56	M	10208	Fall from height/ Blunt injury		2	Colon	1	Conservative, diversion colostomy			12
32	Narparaja	50	M	20811	Accidental fall/ Penetrating injury	1	3,4	Small intestine, major vessels	3			On admission	
33	Seenuraj	34	M	62451	RTA/Blunt injury abdomen		2	Pancreas	1	Conservative			9
34	Subramani	62	M	14413	Fall from height/ Blunt injury		3	retroperitoneal haematoma	1	conservative	Pneumonia		10
35	Kathiresan	44	M	80156	RTA/Blunt injury abdomen		2	Pancreas	1	conservative			13